1920 Vol. XLVIII

OCTOBER 11th, 1945

PRECISION PR
LIBRA

FLIGHT

and

AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

ONE SHILLING

8 MEN AND 2 DINGHIES

After a run-in with a flock of Junkers 88s, eight of the crew of a British-based U.S. Navy Liberator crashed into the winter sea, and were rescued 20 hours later by a British Air-Sea Rescue craft.

"We came down just as the light was failing, hit hard, and her nose went under water. I was stunned, and Lieutenant Lawrence Peterson dragged me out in time on to one of the two rubber dinghies.

"The next day a British air-plane found us and we were picked up by the rescue craft, 19 hours and 34 minutes after we crash-landed.

From the EVENING STANDARD.

DEMOBILISATION ORDER ?

Which bearing groups shall take priority in release for peace-time industry is a question not easily answered. Some bearings whose war service was a simple swing over from peace-time applications have continued in quantity production and should soon be free of all restrictions. Others have had to give way to these victory-winners and their return must be slower. But even if we cannot solve all the problems at once, bearing users can be assured that whatever can be done to make available as soon as possible the widest range of SKF bearings—we are doing it.

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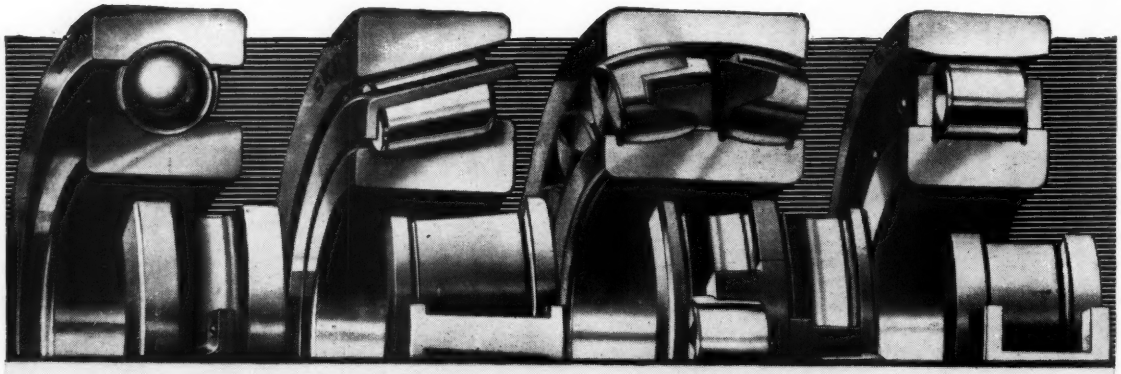

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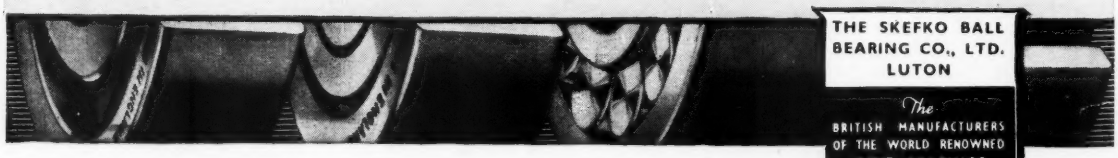

THE SKEFKO BALL BEARING CO., LTD. LUTON

The BRITISH MANUFACTURERS OF THE WORLD RENOWNED SKF BEARINGS

FLIGHT
and
AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

From "Stringbags" to Jets

THE "Silent Service" spoke more eloquently than by words at Heston the other day when, as recorded in this issue, it staged a display of the latest types of Naval Air Arm aircraft. The Admiralty is to be congratulated on taking the decision to disclose so soon after the lifting of the secrecy ban the tremendous change in policy revealed by these new types, a change, incidentally, which was foreshadowed in an article in our issue of June 21st. At that time we were prevented by existing regulations from being more specific so far as Naval air rearmament was concerned.

It used to be said sneeringly of the Navy and its aircraft that it "didn't know what it wanted and wouldn't be happy till it got it." The sneer was never quite true, but the fact remains that until comparatively recently the Navy policy was not doing justice to the air. All that has changed, the first outward and visible sign being the appointments of Admiral Boyd and Vice-Admirals Troubridge and Slattery to the three key positions in the Naval Air Arm.

These three have not let the grass grow under their feet (or perhaps in the case of admirals a simile including barnacles would be more appropriate) as the Heston show revealed. With such visible proof of progress in a remarkably short time, we may view with far greater confidence than before the future of the Navy in relation to its air service. The men now directing its destinies have long air experience, and we may be sure they realise to the full the implications and potentialities of the air in its relation to naval warfare. Never again, we hope and believe, will the Naval Air Arm be the Cinderella of the Service.

The fact that some of the types shown at Heston became available too late to play a part in the Japanese war is incidental, and does not invalidate our faith in the future of the Naval Air Arm. As Admiral Slattery pointed out, they were "rods in pickle" for the enemy. One may be sure that, vast as is the progress marked by these types, those now in charge are looking much farther ahead. The very fact that the Navy already has earmarked two jet types (the Meteor on a carrier is illustrated in this issue) is an indication of a far-sighted policy. We feel that whatever the future may bring in the way of new developments, "The Navy will be there."

Controlling Atomic Energy

PRESIDENT TRUMAN has done well to send a message to Congress on the subject of dealing with atomic energy. Promptitude was desirable, and the President wisely remarked that the discussion of the problem could not be safely delayed until the United Nations' organisation was functioning and was in a position to deal with it.

The first step was to prevent the dispersal of the body of scientists who have been dealing with the problem, and so the President urged Congress to authorise a commission to carry on research and to take precautionary steps to keep all sources of atomic energy under control. British scientists have played their part in developing the atomic bomb; but the whole organisation is in the hands of the United States, and the world should be well content that that is so. The question may be raised whether the dropping of two bombs was really necessary to hasten the defeat of Japan; but certainly no country in the world is more loth than the United States to engage in war. The proposed precautions will probably not prevent other nations from discovering in time how to make atomic bombs; but at least they are calculated to delay that process, and the passage of time will,

we all hope, tend to increase the general love of peace in the world.

There is also the possibility that further study of the atomic source of energy may advance the welfare of the world. If the study were more advanced now, the awful problem of providing Europe with coal might be less critical. These possible benefits lie in the future, but the President of the United States is well advised to start investigations without delay.

Interest in Jet Propulsion

OUTSTANDING interest in turbine jet propulsion was convincingly demonstrated last Friday when Air Comdre. Frank Whittle, C.B.E., R.A.F., read his paper in London. Long before the time announced, the lecture hall was filled to overflowing and a disappointed crowd was shut out unceremoniously, although many had tickets of admission. The paper, which is reviewed in this issue, dwelt mainly upon the historical angle, and as such is a worthy record of the development work associated with Whittle's and his associates' pioneer efforts with turbine-compressor units for jet propulsion of aircraft.

His recount of the many troubles encountered with his original units, of the measures taken to overcome them, the disappointments and tribulations of three long years of endeavour constituted a magnificent example of patience, fortitude and confidence in the final outcome. The many young engineers and students present would appreciate to the full the obstacles which beset the path of any pioneer in engineering, and will take heart therefrom. Whittle was generous in his acknowledgment of the assistance of fellow engineers during his early experiments.

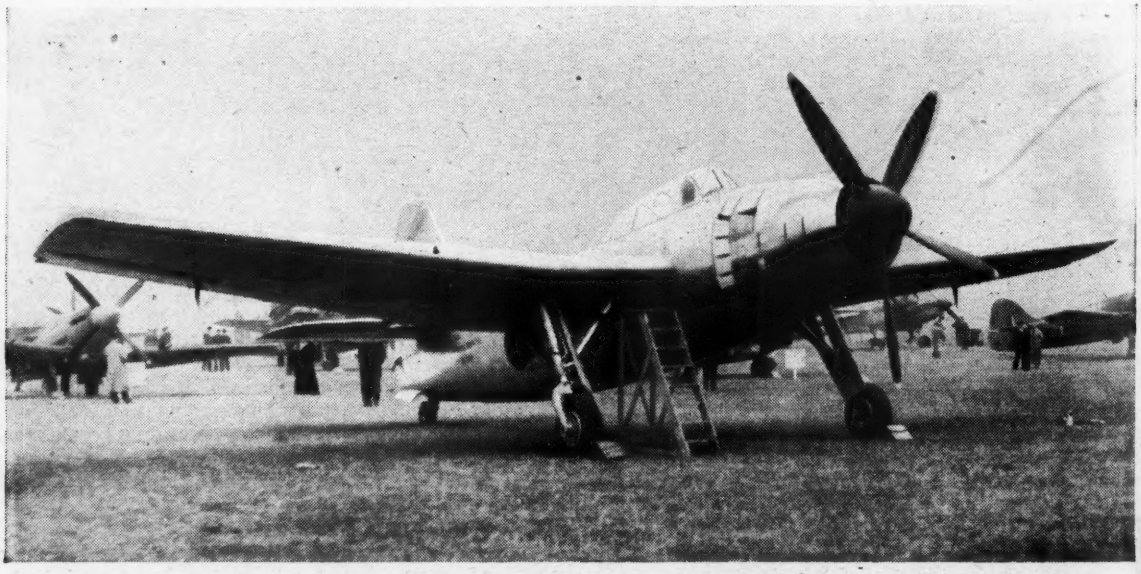
Of later development of great importance he was silent, nor did he indulge in forecasts of possibilities as many had hoped he might. Air Comdre. Whittle did, however, state with emphasis that this country led the world in aircraft turbine production and by implication refuted the statement of the Air Ministry and others who have asserted that German progress with axial flow turbo-compressors and in jet propulsion was ahead of this country at the conclusion of the war—statements made no doubt on the evidence of speeds accomplished by jet-propelled aircraft at that time.

In the absence of official figures, this estimation of speeds has already caused many arguments and unsubstantiated claims from several quarters, and they will go on until officially approved figures of performance have been issued. Nor will such figures if announced in the immediate future equal the speed of sound—the most common form of estimate. At the moment of writing it is extremely doubtful if any aircraft in the world has maintained 600 m.p.h. in level flight, but the day is fast approaching.

In this connection it is interesting to note that three representatives of the Royal Aero Club of the United Kingdom recently attended the first meeting in Paris of the F.A.I. since the war, at which was discussed, among other things, the reclassifications of performances for record purposes. One may assume that the problem of timing speed records was debated. In pre-war days the timing was beginning to get troublesome. At the speeds which will be attained by jet-propelled aircraft there will obviously be greater margin for error, and in view of the various claims to have the world's fastest aircraft, exact timing is essential if results are not to be disputed.

CONTENTS

The Outlook	383
Navy's Newest Displayed	385
Here and There	388
Test Instruments	390
Airscrews	393
De Havilland Dove	395
Early History of the Whittle Jet Propulsion Gas Turbine	399
New U.S. Transports	402
Civil Aviation News	403
Correspondence	404
Service Aviation	406



FAIREY'S LATEST: The Spearfish torpedo bomber, which will eventually replace the Barracuda, was seen for the first time during the display of new types for the Navy at Heston. This particular version is an unequipped prototype. It is Bristol Centaurus powered, and creates something of a precedent in carrying its torpedo in a special bomb bay.

Navy's Newest Displayed

A Most Remarkable Show of New Types : A Carrier-borne Vampire : A New Fairey Torpedo Dive-bomber

THE intensive way in which ship-borne aircraft have developed during the past year or so was confirmed magnificently at the full-dress display put on by the Admiralty at Heston Airfield on October 2nd. On this occasion more "secrets," open and actual, were released than at any other comparable show.

As Rear Admiral M. S. Slattery, who is Chief of Naval Air Equipment at the Admiralty and Chief Naval Representative at M.A.P., remarked in some introductory words, any idea that ship-carried aircraft were necessarily less efficient and less up to date than land-based aircraft had been removed for good. The fact that, as he put it, the demonstrated aircraft could be considered as "rods which had been in pickle" for the smiting of the Japanese, and that the need for them was no longer so urgent, reduced none of the interest. With the requirements of civil production, of course, the plans had been cut down, but production and development would continue.

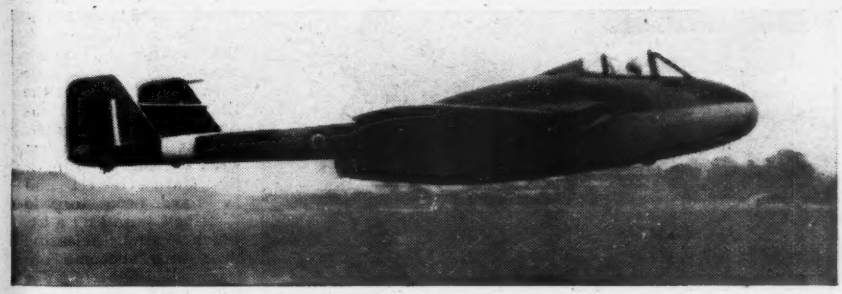
Although not the newest aircraft on show, the D.H. Vampire was especially interesting because this occasion formed the moment at which it was announced as a future carrier-borne fighter. An arrester hook has been ingeniously installed, and deck-landing trials will be carried out during the next few weeks. Any doubts that may have been entertained about its capacity for slow-speed deck-landing arrival were removed when, after a really outstanding display, Mr. Geoffrey de Havilland "motored" quietly in over the south-western corner of Heston to make as short a landing as any seen during the day.

In fact, the entire demonstration was designed, seemingly, to show off the most unusual speed range of the Vampire and its exceptional general handling qualities.

Speed Range

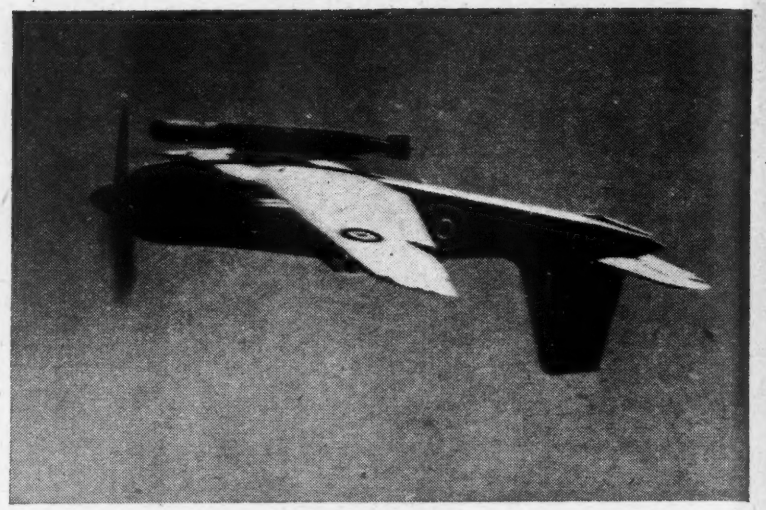
After taxying out, as someone remarked, with the jet "smelling like an oil stove and sounding like a vacuum cleaner," he took it round in a tight circuit from an initial climbing turn and the aircraft was proceeding at something like its maximum speed before it had returned to the take-off point. The fact that it could be repeatedly held, without sign of instability or a vestige of over-correction, in a tight high-speed turn at very little more than ground level, provided ample proof that, skill or no, the Vampire is remarkably good on the controls. After a final high-speed passage, no difficulty was experienced in losing all speed during one complete circuit preparatory to the approach and landing. There is no need to stress the outstanding impression of speed obtained during the demonstration, despite the fact that low cloud prevented the possibility of making anything much of an assisting initial dive. Incidentally, the Vampire, at speed and in the humid conditions prevailing, produced what appeared to be "vapour puffs" over the wing-root air intakes.

An entirely new type to be seen was the Fairey Spearfish torpedo-bomber which was demonstrated quietly, as befitted a prototype aircraft, by the firm's chief test pilot, Mr. Dixon. In its unpainted, shiny-metal state, the Spearfish had something of the look of an American "ship-plane,"



SEA VAMPIRE : The undercarriage is just completing its retractive motions as Mr. Geoffrey de Havilland takes off for his demonstration of the Navy's new jet fighter.

NAVY'S NEWEST DISPLAYED



The Blackburn Firebrand IV, as this picture shows, is equally at home when carrying a torpedo. It is of the new "strike aircraft" class—after attack it becomes a formidable fighter. Examples of the earliest Firebrand mark were fighters pure and simple.

but its five-blader Rotol and Anglicised cockpit layout soon put such ideas out of count. Somewhat prettier when seen in the air than on the ground, the Spearfish is a mid-wing monoplane powered with a Centaurus 57 engine which gives it a maximum of 292 m.p.h. at 14,000ft. and a cruising speed of 170 knots (196 m.p.h.), at which its range is 900 nautical miles. The Centaurus gives the very high take-off power of 2,585 h.p. When in production, the Spearfish will no doubt replace the Barracuda. High-lift flaps are fitted, and the aircraft is designed to take the stresses imposed by rocket-assisted or accelerator take-off. A nice feature from the pilot's point of view is the hydraulically operated hood, or "canopy." In due course it is possible that a reversible-pitch airscrew will be standardised, for use not only in normal deceleration after landing, but also as a dive-brake function which may have interesting experimental results during early tests, since it will be difficult to theorise on the actual movements of the airflow over the tail surfaces. A crew of two is carried, and both torpedo and bombs will be faired in a bomb bay—an innovation as far as British single-engined torpedo bombers are concerned. Other armament consists of two 0·5in. guns firing forward and two from a Nash and Thompson rear turret. The span is 60ft. and the all-up weight approximately 24,000 lb.

Two other Fairey products were demonstrated—the Barracuda V and the Firefly IV. The former is Griffon-powered, while the previous Barracudas have been fitted with Merlin engines; the span has been increased to 53ft. 2in. to deal with the additional weight of power unit and necessary extra fuel, while a larger rudder and dorsal fin have been designed. The maximum speed of this new version of the Barracuda is given as 244 m.p.h. at 15,000ft.

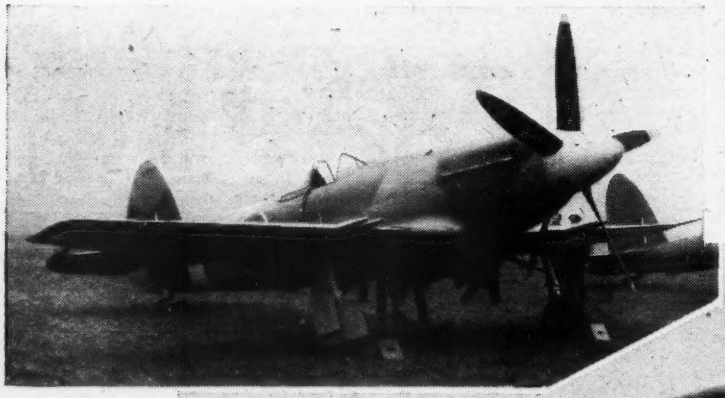
The most obvious difference to the casual eye in the Firefly IV, in comparison with previous marks, is the way in which the radiators have been installed in the leading edges, while the wings have been clipped to give improved lateral control at low speed. The IV has a Griffon 74 engine, giving it a better ceiling and rate of climb at intermediate altitudes. Mr. Evans, who demonstrated the Firefly, gave us a little piece of inversion with the undercarriage down to provide an idea of the aircraft's aerobatic safety and good control in odd attitudes at low speeds.

General details of the D.H. Hornet have already been published, but the Naval version is rather more than merely a 'Ornet with a 'ook. The Sea Hornet, as it is to be called, has hydraulically folding wings, with a very quick action, as demonstration proved with a ground rig, as well as the fittings necessary for rocket or accelerator take-off assistance.

Long-range Fighter

This aircraft has carried out its deck-landing trials successfully, and the story goes that on one of these, following hydraulic trouble, the pilot brought it on to the deck while keeping the flaps down by hand-pump pressure. Since he would also be busied with the throttles, one can only surmise that he held off and landed with his teeth. No guarantee for the accuracy of this story is given, but even if it is partly true and garnished greatly in the telling, the fact that it was put down safely says a great deal for the good slow-speed characteristics of the Hornet. During the demonstration at Heston the pilot spent most of his time with one airscrew feathered—a condition in which the Hornet appeared to be more than happy. The Naval version of the Hornet is being built by the Heston Aircraft Company, who, we understand, were responsible for the development of the wing-folding mechanism.

In its earlier forms the Blackburn Firebrand was designed as a fighter, but, as described in last week's issue of *Flight*, the Mark II, III and IV have been torpedo "strike" aircraft, which, after releasing their load, become untrammelled fighters. The



Forming an interesting comparison with the new Spiteful is (below) the Seafire 47, with its contra-rotating airscrews; the 45, 46 and 47 are Naval daptations of the Spitfire 21 and 22.

The Supermarine Spiteful is seen for the first time (above) in its Naval Seafang form. An exceptionally wide track undercarriage, inwards, and the thin, laminar flow wing are features.

NAVY'S NEWEST DISPLAYED

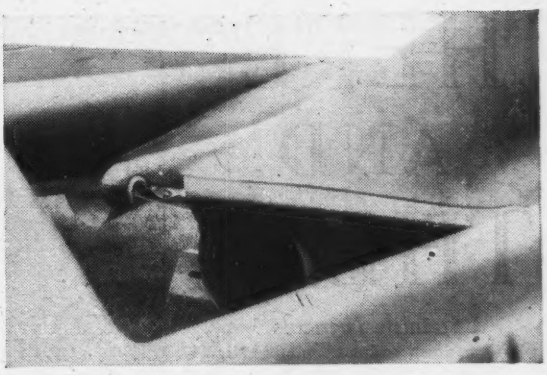
fact that it is adequately manœuvrable even while carrying a torpedo was well shown at Heston. As a matter of interest, the addition of a torpedo makes a difference of merely 8 m.p.h. to the maximum speed and 400 ft./min. to the initial rate of climb.

A development of the Tempest II, the new Sea Fury has been considerably modified. In order to improve performance, manœuvrability and storage ease the span has been reduced by removing the centre-section and joining the wing roots. The example to be seen at Heston had "solid" wings, but on the production version these will be of the power-operated folding type. In order to obtain the necessary extra thrust for deck take-offs—and also, presumably, to reduce the deck clearance—the Sea Fury has a five-blader airscrew for the Centaurus. Mr. Humble, cheating the forces of artificial gravity with the aid of a Farnborough G-suit, showed us what the prototype Fury would take in the way of vortex-forming loads.

Lineal descendant of the Spitfire series, the new Supermarine Spiteful was shown for the first time at Heston in its hooked form—wherein it is to be known as the Seafang. In this form it will have folding wings—no mean accomplishment when dealing with present-day sections—and contra-rotating airscrews. The Spiteful, as is generally known, has an entirely redesigned wing section of the laminar flow type, and the undercarriage, folding inwards, is comfortingly wide. At Heston the Spiteful-Seafang was demonstrated by Lt. Cdr. J. K. Quill, who has been Chief Test Pilot for the parent Supermarine-Vickers firm since the early Spitfire days.

Other examples of the Supermarine series to be seen in the air and on the ground were the well-known Seafire III, complete with rockets, and the latest Marks 45 and 47. The last, with contra-rotating airscrew, was not flown, but Mr. Henshaw put up one of his expectedly good shows with a 45—which is the Naval version of the Spitfire 21, described in last week's issue. The Monitor II, also described last week, can hardly be considered as a Naval type, but as it is used for high-speed fleet target-towing duties, it was rightfully shown and flown at Heston.

The Sea Mosquito, also on show, is interesting not only because it has been adopted by the Navy, but because it was probably, in R.A.F. form, the first high-efficiency twin to carry out deck trials successfully. The fact that these were being made was very much a closed secret for some time. The Sea Mosquito has folding wings, and the rubber-ring undercarriage suspension has been replaced by normal oleo-pneumatic struts so that the greater loads and consequent rebound of slow, stalled landings can be taken satisfactorily. In order to make room for the necessary special Radar equipment in the nose, the four .303 guns of the normal Mosquito have been removed, leaving the still adequate armament of four cannons.



THE VAMPIRE'S STING: How the arrester hook is installed in the D.H. jet fighter. It is suspended from two mainplane ribs and attached, when retracted, to the exhaust cone cowling.

In addition to the complete aircraft on show, there was also at Heston a small exhibition of other items, including a mobile equipment van for general maintenance, and a new type of Naval airborne lifeboat designed by Faireys and looking very seaworthy with its "solid" hull. Following Naval tradition the occupants are expected to make full use of natural forces and the sails are adequate for power and full control—there was nothing of the temporary expedient about the rig.

Unconnected with the display, but interesting nevertheless, was O. F. Maclaren's show of his firm's new system by which battle damage to the coolant systems of fighters is automatically combated. By means of a series of electrical contacts, damaged sections of these coolant systems are immediately cut off with Isolator valves.

The Fairey Aviation Company, who are now based at Heston since the start of the work on the new civil airfield at Heath Row, provided an indoor show of dioramas covering the Taranto attack by Swordfish on the Italian Navy and the record of sinkings from Malta by the Fleet Air Arm with the same type of aircraft. In their exhibition, too, was the Fairey experimental "double" aero engine and the contra-rotating airscrew which it drove. Whether the firm will ever return to the manufacture of engines and airscrews remains to be seen, but they have other and much more interesting developments in progress about which we shall be allowed to write in due course.

In all, the demonstrations at Heston were such that the visitor suffered from a form of "new type indigestion." It is impossible to do full justice either to the many types displayed, or to the feeling of optimism for the future which the entire show produced in anyone who is interested and realises the vital importance of our sea-air power in the future. Nearly a dozen new or considerably modified aircraft were to be seen and examined at Heston, each one of them showing a considerable advance on previous types in the same category.

All ideas of relative ship-borne performance have gone by the board, and, thanks to the energy of technicians and the not inconsiderable courage of experimental deck-landing pilots, it has been shown that any modern aircraft with good low-speed control can be converted or redesigned for carrier use.

Mr. Humble shows off the Sea Fury, which is the Naval version of the Centaurus-engined Tempest II.

Hydraulically folding wings are a feature of the Sea Hornet. This aircraft has already completed its deck trials.

HERE AND THERE

Spanish Thermals

TWO Spanish sailplane pilots, Miguel Ara and Vincente Juez, claimed recently to have set up a new world's altitude record for two-seater sailplanes by reaching a height of 18,372ft. over a small village near the Pyrenees.

A First Issue

THE first issue of an American publication entitled *Atomic and Gas Turbine Progress*, dated October, reached our offices last week. The main article, by R. Tom Sawyer, compares the Diesel Engine and the Gas Turbine. Not surprisingly, perhaps, atomic subjects are lacking.

Meteoric

THE Gloster Meteor jet-propelled aircraft which, as mentioned in *Flight*, August 30th last, was being presented to the R.C.A.F. by the British Air Ministry for experimental purposes, was recently reported to have flown from Montreal to Ottawa in 12 minutes. The distance is just over 100 miles, so the speed was better than 500 m.p.h.

The Meteor, which was making a series of test flights from the R.C.A.F.'s Montreal airport at St. Hubert, was flown on this occasion by Sqn. Ldr. E. L. Baxous, D.S.O., D.F.C., of Nova Scotia.

Club Activity in Eire

THE IRISH AVIATION CLUB, which has provided special courses in ground subjects for its members during the war, now has some 100 potential "A" licence pilots awaiting their flying instruction. Of these 60 are members of the Dublin branch and the rest belong to Limerick and Kildare. New branches are to be started at Galway and Cork in due course.

As in the U.K., there is as yet no information in Eire as to when clubs and private owners will be allowed to resume flying activities.

The small fin on the nacelle of the Handley Page tailless supplements the fins and rudders on the wing tips. The engines are de Havilland Gipsies.

Naval P.R.U.

IT was made known for the first time last week that a special squadron of carrier-based Hellcats was trained in the Outer Hebrides for the job of photographing the Malayan coast from 30,000 feet to get vital landing beach information. The squadron's aircraft-carriers operated from Ceylon.

This Naval Photographic Unit of the East Indies Fleet—the only one of its kind in the Royal Navy's Fleet Air Arm—used specially adapted Hellcats on which cameras comprised the only "armament."

Experience gained by the P.R.U. in Britain with unarmed Spitfires and Mosquitoes must have proved very useful to this squadron.

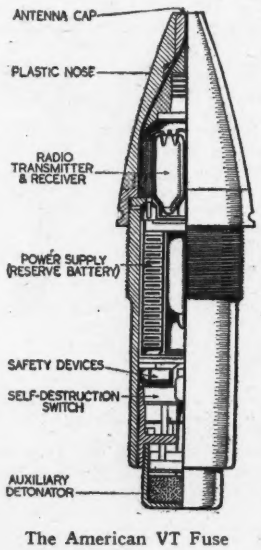
"Bonzo"

FIRST mention of the radio proximity fuse, released by the U.S. Navy Department, was published in *Flight*, September 27th. Now comes the first available picture in the form of a sectional drawing showing the layout of this clever device which explodes a projectile when it gets within 70ft. of its target.

This picture is also of American origin and, as might be expected, gives the entire credit to American scientists and says that the fuse was first used in the "Battle of the Bulge" in December, 1944.

It may well be that the U.S. version of the radio proximity fuse—the VT fuse—was first used at this time, but the British model, known by the non-committal name of "Bonzo," was, as we stated a fortnight ago, used with conspicuous success by A.A. Command in the fight against the flying bomb during the previous summer.

Furthermore we agreed not to use it against the doodle-bugs at Antwerp in case the enemy captured one intact, learnt the Allied secret of uncannily accurate A.A. fire and passed it on to the Japs.

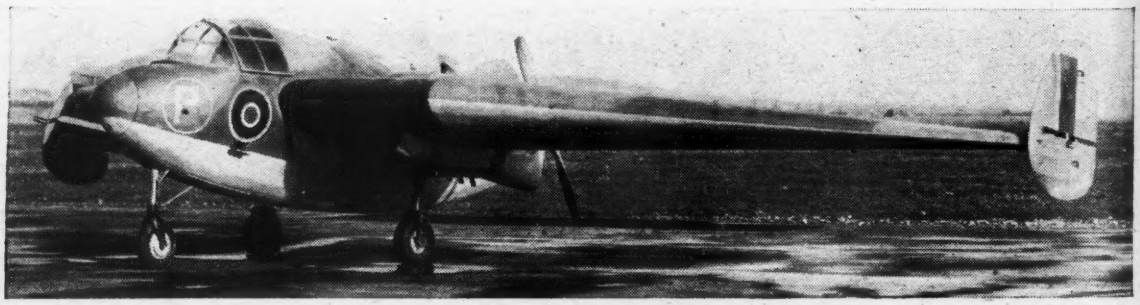


The American VT Fuse

Powered Hamilcar

HOLIDAY-MAKERS on the Hampshire coast who saw, fairly recently, a strange aircraft flying around that looked remarkably like a Hamilcar glider except that it had a couple of radial engines, were quite right; that is precisely what it was.

This power-assisted Hamilcar was among the interesting array of exhibits at the recent A.T.A. exhibition, and



TAILLESS RESEARCH: Over the district surrounding Radlett, this unusual-looking Handley Page monoplane has been a not infrequent sight in recent months. It may be assumed to be a flying scale model for collecting data for larger machines

HERE AND THERE

Flight's representative was told that its two Mercury engines (looking almost comically small on that 110ft. span) would take it off when light and keep it in the air when loaded, but they could not achieve a take-off with load.

The Mercuries assist the towed take-off under a full load, and when operational height is reached the tug can cast off and leave the power-assisted glider to carry on to its destination.

The idea is not new, of course. The Me 323 transport sprang from the Me 321 glider transport to which engines were experimentally fitted, and the American CG-4 was ferried empty on a pair of Franklin or Lycoming horizontally opposed units which were quickly detachable.

Transition

THE organisation of a Volunteer Interim Air Force, which will serve two years while the nature and size of the permanent Royal Canadian Air Force is decided, has been announced by Mr. Colin W. G. Gibson, Canadian Air Minister.

The Volunteer Force will receive the same Service pay and allowances and will work under similar terms to those applying to the occupation force of 10,000 airmen overseas.

COMFORT AT A HIGH LEVEL: This view of the interior furnishing of the Vickers-Armstrongs Viking shows the degree of passenger-comfort it will provide for peacetime travellers. The padded, winged headrests should certainly prove a boon on a long trip.

News in Brief

THE A.T.A. exhibition and pageant at White Waltham raised approximately £3,000 for the organisation's Benevolent Fund, and Lord Beaverbrook added a gift of £5,000 to this sum.

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Of the 708 surplus aircraft sold during August by the Canadian War Assets Corp. (Aircraft Division), 399 went to purchasers within the Dominion. They realised $121,859, and an additional $108,332 came from surplus aircraft engines and equipment.

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The newly formed Lancester, Morecambe and District Aero Club is to have a Taylorcraft Auster placed at its disposal for instruction and demonstration purposes by Loxhams, of Lancaster, who are agents for this aircraft. Gliding will also be among this club's activities.

Air Marshal L. S. Breadner, retired chief of the R.C.A.F. overseas, says that Canada must have a permanent air force of not less than 30,000 men with modern aircraft and facilities. "Peace never lasts for ever," he said, "and Canadians cannot afford to gamble that they will be able to mobilise in the customary leisurely fashion."

* * *

Hangar space at the Dublin airport, Collinstown, has been taken by Miles Aircraft, Ltd., who are to establish an overhaul and servicing depot there in the near future. This firm is also reported to be considering the opening of a training school in Eire.

* * *

Sgt. Henrietta Williams, of the American W.A.C., the first enlisted woman to enter the China operational theatre, was last week invested with the Air Medal by Lt. Gen. Stratemeyer, chief of the U.S.A.A.F. in that theatre. She had flown 25 missions as navigator within range of Jap fighters.

* * *

The following changes in the Vickers-Armstrongs organisation are announced: Mr. P. H. Muirhead becomes general manager of the Elswick, Scotswood and Chertsey works in place of Cmdre. E. R. Micklem, owing to the latter's increased responsibilities as deputy chairman and managing director (engineering works and shipyards). Mr. B. W. A. Dickson is appointed general manager of the aircraft section, and Sqn. Cdr. Sir James Bird relinquishes the post of general manager of the Supermarine works and becomes advisor to the managing director (aircraft) of the company. Messrs. Dickson and Muirhead are also appointed directors of Vickers-Armstrongs, Ltd. All appointments take effect from Oct. 1st.

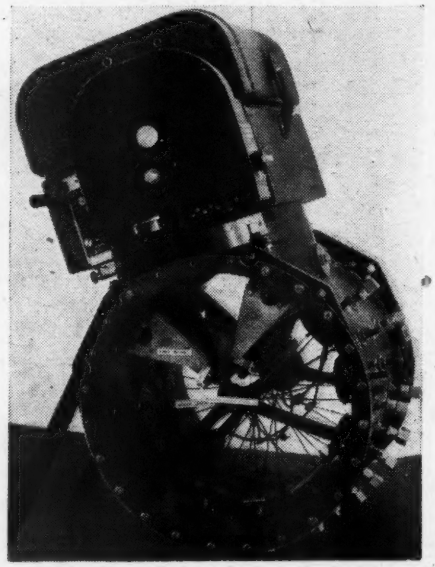
DOOR-STEP 'DROME: The AOP landing strip is being laid within a few hundred yards of the Schönbrunn Palace, the British H.Q. in Vienna, for the use of the little Austers (seen in the background) which maintain quick contact between various British headquarters in Austria.

Test Instruments

Comprehensive Exhibition of Test Instrumentation for Aircraft at R.A.E. Farnborough

THE job of designing an aircraft, or, if it comes to that, any of the ancillary components which go towards its make-up, is to-day almost exclusively a scientific undertaking. In years gone by the creation of an aircraft was to a certain extent dependent upon the personal and native ingenuity of its designer, but that state of affairs has been receding steadily into the background until to-day an aircraft is evolved almost, it can be said, purely from the laboratory. This is not to suggest that the quality of the designer is any the less important, it merely means that for enhanced performance the results of tunnel, laboratory and scientific research work are the only field to which the designer can turn to obtain the information which no native ingenuity can inherently embrace.

With such a background it is, therefore, quite understandable that the collation of information as to the behaviour of not only the aircraft itself but the various bits and pieces which contribute to its performance is rather more than a test pilot can personally record. For this reason a great deal of use is now made of grouped test instruments which are automatically photographed, by specially installed ciné cameras, to provide a record of what is going on during any particular phase of aircraft manœuvre. We believe we are right in saying that Hawker's were one of the first firms ever to use this system, which has now become quite general.



Multi-capsule manometer by means of which pressures at 32 different points, e.g., on a wing, may be recorded by the camera above the drum.

Covering information during test flying naturally enough calls for specialised instruments which are both more accurate and more sensitive than those with which an aircraft is normally equipped. In addition there are, of course, many instruments used in experimental flying which are applicable only to such work and would not be suitable for installation as normal equipment in the majority of machines, although some of them might well be fitted in the ultra high speed types where critical conditions exist in the approach to the sonic threshold.

Stringent Requirements

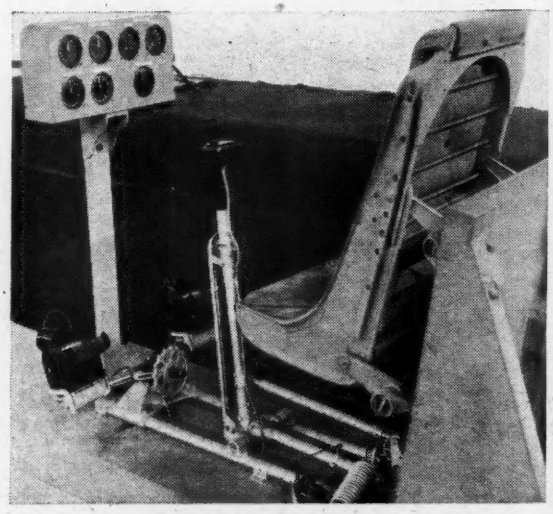
The Royal Aircraft Establishment in collaboration with other M.A.P. establishments and various aircraft and instrument firms arranged an exhibition of test instruments and devices at Farnborough which was extremely comprehensive and very enlightening, showing as it did the tremendous amount of research and development work which has to be undertaken in order to gain any increase of performance above normal levels.

That most of the instruments exhibited have been evolved to permit accurate measurement in abnormal conditions connotes that they have to satisfy quite stringent requirements which demand special design and construction techniques, as well as special methods of application. The requirements may be summarised very briefly as embracing the properties of high sensitivity, rapid response characteristics, ability for remote indication or recording, and simultaneous recording of more than one phenomenon, and, as these characteristics and others of a special nature are possessed chiefly by devices employing the comparatively inertia-free electronic valve and cathode-ray tube, many of the exhibits were, therefore, of this character.

A quite interesting aspect of the exhibition was that a considerable proportion of the devices shown were concerned with the measurement and recording of vibration, this having a realm of very real importance associated with the reduction of weight to a minimum consistent with sufficient strength and also the attainment of a high order of mechanical efficiency.

In the aerodynamic section of the exhibition were various accelerometers, almost all of which embody recording devices and almost all of which incorporate the Desynn system of transmission. As a matter of fact, it was interesting to note that the Desynn system was applied to a great many of the instruments and devices shown, it being peculiarly fitted for the transmission of motion to a remote indicator except in such instances where the input force is extremely low. In such cases it is possible that the friction in the wiper arm of the potentiometer might actually be in excess of the input force and thus render the system ineffective.

Among the air speed indicators, all of which had in common the quality of high sensitivity, was a Smith instrument having two pointers, the longer making one revolution for each 100 m.p.h. and the shorter making one-tenth of a revolution for a similar value, the relative boldness of the pointers being such that rapid assumption



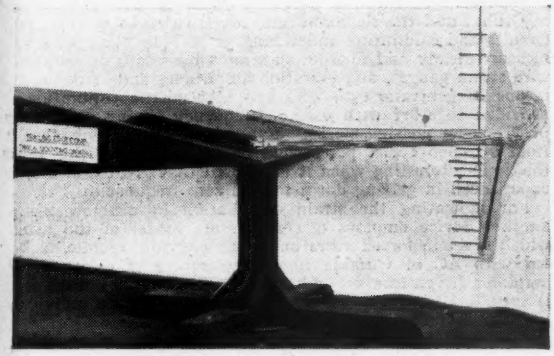
Control forces and movement mock-up. In an actual installation the panel of dials would be mounted somewhere in the aircraft and automatically photographed.

of high speed during aerobatics may be made. The accuracy of this instrument even for landing speeds is ± 2 m.p.h.

The Kollsman G.1 is another rather interesting instrument which is unusual in that it indicates true air speed, automatically computing three functions—pitot pressure, static pressure and air temperature—by means of three capsules. All three are exposed to static pressure externally, but internally one has pitot pressure, another is evacuated and the third has vapour pressure. All are connected to the pointer mechanism by means of linked fulcrums; and a bimetallic link is introduced to correct temperature variations. With regard to this instrument there was, however, no exhibited indication of its degree of accuracy in registering true speed.

Mach meters of three types were on view. Actuation in each case embodies a mechanical linkage by which the motion of a capsule subjected to pitot-static pressure is suitably modified by the motion of an aneroid capsule subjected to the same static pressure so as to read directly the Mach number.

Another interesting instrument was a multi-capsule manometer used for pressure-plotting in flight. This instrument consists of 32 capsules arranged around the inside of a cylindrical body, with each capsule connected by a simple lever system to a bell-crank carrying a small mirror pivoted

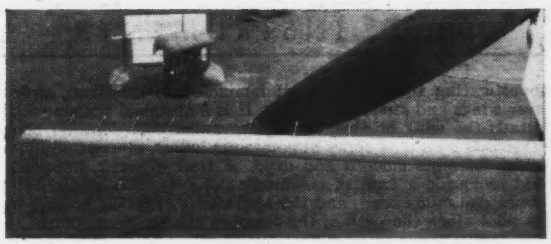


Pitot-comb for registering variation in flow from behind a wing.

on the axis of the cylinder. A projector system consisting of lamp, lens and cross-wire projects a spot of light on to the mirror whence it is reflected on to the film contained in an F.8 camera. Each of the capsules is connected to a union on the exterior of the cylinder so that tubes from, say, 32 different points along a wing can each be connected to a capsule, and thus a pressure diagram of the flow form over the wing for any particular flight condition may be recorded on the film.

A trailing static instrument for the measurement of static pressure of the air without interference from disturbed air flow about the aircraft consists of a closed tube having a number of small lateral holes, fitted to the nose of a streamlined body with tail-vanes to keep it at zero yaw and pitch. The instrument is suspended from the aircraft and static pressure is conveyed to the static side of a A.S.I. This particular instrument might well be used in conjunction with a special Venturi-pitot device which measures correct total head of airstream up to 40 deg. angle of incidence relative to the moving air. It consists of a small pitot tube with its open end pointing downwind embodied in a Venturi tube, the pitot pressure being conveyed to the pitot side of a A.S.I.

A rather ingenious instrument devised primarily for small aircraft carriers is a wind-direction and velocity indicator incorporating a wind vane carrying a slotted spring plate. Rotation of the vane and deflection of the slotted plate is registered through standard micro-Desynn transmitters, the accuracy of the instrument being approximately ± 2 deg. for wind direction and ± 0.5 knot over a range of 10-45 knots wind velocity.



Pitot-comb (port) behind Spitfire airscrew to investigate behaviour of flow at very high speeds.

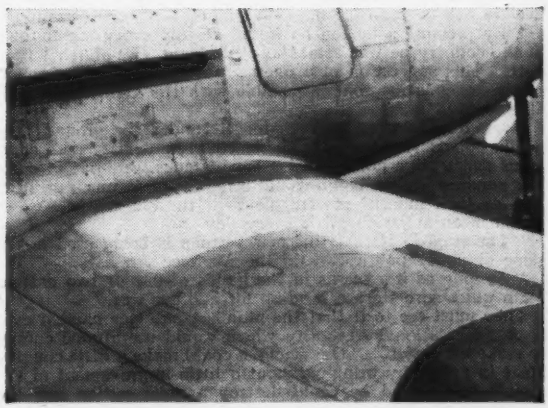
Gyroscopic instruments included a rate-of-roll meter embodying a spring-restrained Schwein electrically driven gyro in conjunction with a standard Smith's micro-Desynn transmitter and receiver to record rates of roll of fighter aircraft. On a range with a maximum of 0-250 deg. per second readings are obtainable to within ± 2 deg. per second. At the other end of the scale another rate of roll meter employing a three-phase A.C. squirrel-cage gyro actuating a micro-Desynn transmitter provides, due to the large moment of inertia and high speed of the gyro rotor, for the recording of very low rates of roll. For example, on a range of 0-15 deg. per second readings are obtained to within ± 0.1 deg. per second.

Control Forces and Movements

Considerable space in the exhibition was devoted to control force and movement indicators of various types. Many of these were for specific applications only, that is to say elevator or aileron or rudder forces, but an interesting mock-up (a photograph of which we include) showed the installation for both control force and control movement indicators set up in an instrument panel so that the inquisitive could test how it worked. The system embraces R.A.F. miniature Desynn transmitters and standard Smith's receivers, and records control force to within an accuracy of ± 0.5 lb. In actual fact the indicator panel would not, of course, be fitted before the pilot, but would be placed somewhere in the aircraft in conjunction with a camera to record the readings given.

Another ingenious device, a mock-up of which was shown, is a flying control space/time recorder for measurement of control deflections and differential motion against a common time scale. The purpose of the instrument is, for example, to record the time lag, etc., between a pilot's input movement and the output movement of a servo unit to operate a control service.

A very interesting system which does not truly come under the heading of instrumentation is concerned with



Chemical coating on wing of Kingcobra for graphic indication of breakdown from laminar to turbulent flow.

TEST INSTRUMENTS

investigating the transition of laminer into turbulent airflow over wings and airscrew blades. It is a chemical system which entails the wing or airscrew surface under consideration being sensitised by a mist spray of potassium-iodide, starch and hypo, which becomes smooth and dry. A trail of weak chlorine is laid alongside a trail of coloured smoke by an aircraft flying about one mile ahead, and the aircraft to be tested is flown by its pilot along the path of the coloured smoke, so ensuring that the machine flies through the trail of gas. Areas of turbulence cause a surface darkening of the chemical treatment and by so doing illustrate the position and area of breakdown. This is applicable not only to normal airflow characteristics, but also embraces boundary layer characteristics.

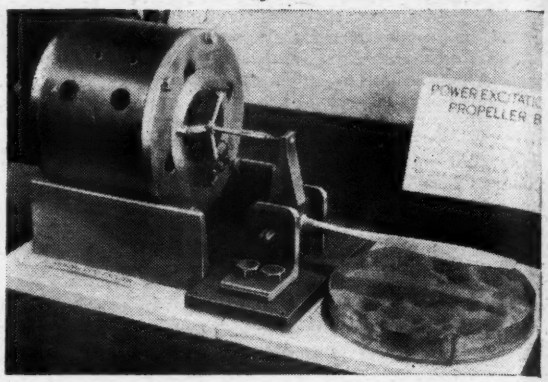
In connection with the latter the small dimensions of the boundary layer on low drag wings enables the profile drag to be measured in flight by means of a small vertical comb fitted behind the trailing edge of the wing. The prongs of the comb are pitot tubes, and the small size and weight of this installation makes it particularly applicable.

To enhance the efficiency of airscrews and so stave off for a time their eventual eclipse by direct-reaction propulsion, an installation exhibited on a Spitfire incorporates a calibrated engine, and horizontal combs projecting from the nose immediately behind the airscrew whereby a measurement of the total head can be made in order to determine airscrew efficiency. Special apparatus incorporated includes (i) total head combs; (ii) pitot-static head designed for high speed with large-bore tubes to reduce lag; (iii) differential pressure gauges with a range of 4in. w.g. and giving scale readings of 0.02 w.g.; (iv) underwing electrical thermometer connected to Tinsley reflecting galvanometer giving lagless readings to ¼ deg. C.; (v) airscrew pitch indicator of Desynn type reading to about ¼ deg. Readings are given on a grouped panel of dials and recorded by a high-speed Vinton camera.

Structural Section

In the structual section of the exhibition many of the instruments were electronic embodying photographic recording of the cathode oscillograph traces, and included vibrographs, resonance testing equipment and vibration recorders of various types.

Of the strain recording equipment, a very interesting exhibit was a 16-channel mobile recording set of de Havilland's which provides input connection for resistance strain gauges or electromagnetic vibrographs, connected in two groups of 16 each from 32 input circuits. After amplification, the signals are applied to the galvanometer unit of the recording camera. This exhibit included a de Havilland four-blade hydromatic airscrew to which the "pineapple" hub strain gauge and cemented pick-ups on two blades were fitted, the whole being erected in a stand and the excitations recorded by the equipment.



Excitation of model airscrew blade to give sand patterns according to type, location and area of particular strain.

Another very interesting exhibit was the six-channel cathode-ray oscillograph recording equipment which is likely to become standard for the industry, having been designed as standard for multi-channel recording during ground tests. It is made up of a main tube and camera assembly which houses six cathode-ray tubes and the six amplifiers, and two racks housing pre-circuits and calibrating and timing gear. The equipment will measure steady and fluctuating strains by means of resonance wire strain gauges, and vibration amplitudes and velocities by means of generator-type pick-ups. Automatic calibration is provided together with variable-frequency timing marks and provision for phasing marks. Range is quite wide, frequencies from 0-10,000 cycles per second being recordable; this is all the more interesting when it is realised that great difficulty is experienced in getting down toward zero frequencies.

For indicating the strain distribution in airscrew blades another device employs a 1/10th scale model of the blade, which is set in forced vibration by an electro-magnetic exciter fed with AC of variable frequency from a 200-watt power amplifier driven from an audio-frequency oscillator. Fine sand is sprinkled on the model blade and is shaken into individual patterns according to the frequency of excitation.

Although, for reasons of space, we have here given only a brief résumé of some of the more interesting exhibits, the show was remarkably comprehensive and absolutely up to date. The authorities concerned are to be congratulated on having the foresight to recognise the great deal of good which can only accrue from such a function.

ONE-MAN ARMY WITH ATOMIC BOMBS

A GRIM picture of a future war was painted by Air Vice-Marshal D. C. T. Bennett in an address on the atom bomb and civilisation to the London Institute of World Affairs last week.

If it were wrongly used, he said, the Prime Minister of England, sitting in a control room at 10, Downing Street, could declare war by releasing 6,000 atomic rockets on the enemy.

"By pressing a button he would destroy every major town in the country he was attacking," declared Vice-Marshal Bennett. This suggestion of a one-man army is no wild figment of the imagination, but is possible with the knowledge available to-day."

Even if they were to live 5,000ft. under the ground they would not really be safe, as bombs could be devised with enormous penetrative powers. All other weapons were out of date. The smallest atomic bomb would bring about as much destruction as took months of struggle with the old weapons. It would mean a Passchendale every day.

"The tragedy is that this new weapon is being used in the game of power politics," said the Air Vice-Marshal.

"As long as it remains in the hands of one or two nations I am quite sure we are heading for another war."

They must see to it that the atomic bomb was handed over to an International Authority which would use atomic energy to make life easier. "One scientist could make a little country great in power by bringing about a little improvement of the atomic bomb, and he could destroy a great nation like the U.S.A. in five seconds," he said. "The whole balance of power has been upset by this discovery, and in future the big nations would no longer be all powerful."

BOMBER COMMAND TRANSPORTS TROOPS

SINCE August 1st, Lancasters of R.A.F. Bomber Command have been engaged in a regular transport service to and from Italy. About 60 aircraft a day are employed.

To date, 44,000 troops have been brought to England and 3,000 taken back. Some of the men were coming home on release and others were on a month's leave. The Lancasters carry 20 passengers and land at Pomigliano and Bari in Italy. The journey from England takes between six and seven hours, and the air crews are given 24-hr. rest in Italy before returning.

Three aircraft fly to Berlin each day taking air crew and a few of the grand staff to see the bomb damage and conveying Service personnel of the occupying forces who are going on leave.

A.T.C. AN INTEGRAL PART OF THE R.A.F.

"AT all places visited, co-operation between the R.A.F. stations and the Air Training Corps was excellent, and the Air Training Corps is being regarded more and more as an integral part of the R.A.F.," says Air Chief Marshal Sir Robert Brooke Popham in a report on Air Training Corps for 1945.

Sir Robert and three other senior R.A.F. officers have just completed a series of inspections of stations where over 60,000 air cadets have been undergoing their week of annual training under service conditions.

The inspecting officers found that at most stations it was taken as a compliment to the Corps that "any failure on the part of the A.T.C. to live up to its high reputation for smartness and good discipline comes in for criticism" as though they were full members of the R.A.F.

Airscrews

A Specialist Examines Their Future Scope and Probable Development in the Next Five Years

NOT inappropriately, the first Royal Aeronautical Society lecture of the season, given last Thursday, was on the subject of aircraft propulsion. We are on the eve of great changes; in fact, the jet and turbine may be said to mark the opening of a new chapter in flying. Mr. L. G. Fairhurst, chief engineer of Rotol, had chosen as his title "The Future Scope of Propellers." We have taken the liberty of substituting the word airscrew in conformity with our usual custom, since this applies logically to all layouts.

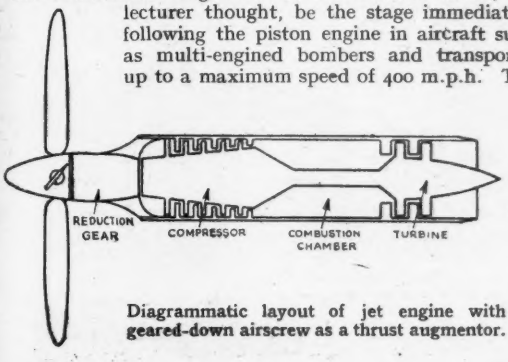
Mr. Fairhurst has written a most admirable paper, and one which must be studied in detail by technicians. We can but give a general outline of his arguments and conclusions. Ultra high-speed flight at great altitudes presents the greatest problems, and a considerable part of the paper deals with this subject.

By way of background Mr. Fairhurst showed curves of increase in b.h.p./relative density and in aircraft speeds during the years 1939-1945. The former ratio rose from a value of about 1,000 to one of approximately 5,000. Aircraft speeds rose from 300 m.p.h. to 460 m.p.h. in the fighter class. In the same period the airscrew designer catered for the increasingly difficult requirements by producing, step by step, the three-blader, the four-blader, the five-blader, and the six-blader contra-rotating airscrew. The end of the war had taken us up to engine powers of 2,400-2,800 b.h.p. The next stage to be considered was the engine of a basic 3,000 b.h.p. capable of development up to 4,000 b.h.p., and a basic of 4,000 b.h.p. capable of being developed up to 5,000 b.h.p., the former for use in fighters and the latter for bombers and transport aircraft. The airscrews to cater for these types ranged from six-bladers (3+3) to contra-rotating ten-bladers (5+5). The greatest diameter envisaged was of about 21ft., this being a 4+4 for 5,000 h.p. engines working at 40,000ft.

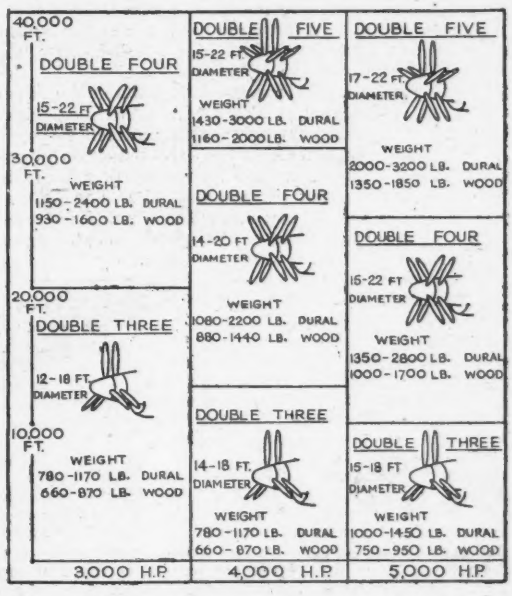
Turbine-Airscrew Combinations

When changing from piston engine to jet and turbine/airscrew combinations the lecturer foresaw two classes: straight jet with airscrew, and gas turbine engine and airscrew. For the former combination he forecast that an airscrew used as a thrust augmentor and absorbing some 20 per cent. of the power would improve take-off and initial climb by 45-50 per cent. One difficulty might be that of control of the airscrew by a governor responsive to the r.p.m. of the whole unit. The solution might be to have a separate turbine to drive the airscrew. This would ensure satisfactory constant-speeding on take-off and climb, and the neutralisation of the airscrew at top speed could be done by feathering.

The combination of gas turbine and airscrew would, the lecturer thought, be the stage immediately following the piston engine in aircraft such as multi-engined bombers and transports, up to a maximum speed of 400 m.p.h. The propulsion unit would comprise the usual compressor, combustion chamber and turbine, the latter driving the airscrew through a reduction gear, as shown diagrammatically in one of the illustrations we reproduce. Approximately 80 per cent. of the power would be allotted to the airscrew, the remaining 20 per cent. issuing in the exhaust gases as kinetic energy. The lecturer would expect to see turbine/airscrew units of 1,000 h.p. to 10,000 h.p. over the next five years. Operating altitudes of 10,000ft. and 40,000ft. were considered the most extreme to be met, and curves were shown which depicted the range of airscrews appropriate to these conditions at 300 and 400 m.p.h. These included four-bladers, five-bladers, double-threes, double-fours, and double-fives. For maximum efficiency, diameters of 30ft. would be necessary at 40,000ft, and these would present serious problems to the aircraft designer.



Diagrammatic layout of jet engine with geared-down airscrew as a thrust augmentor.



Pictorial analysis of future airscrew types for engines of 3,000 to 5,000 b.h.p.

On the subject of ducted fans the lecturer was not very optimistic. The advantages were not considered very great, and the disadvantages considerable, especially the size of fan and ducts required to deal with the large volume of air.

The next section of the paper dealt with aerodynamic development needed in connection with high-speed, high-altitude flight. Blade sections would have to be thinner, and with the maximum ordinate much farther back than the ones used previously. Another means of keeping airscrew helical tip speeds at a reasonable local Mach number was the two-speed gear. This could, at 550 m.p.h. between 25,000 and 40,000ft., reduce the tip Mach number for top-speed flight to something like 0.95— 97, a value commonly used in normal design.

In dealing with contra-rotating airscrews the lecturer also referred to what he termed co-axial airscrews, viz., a type in which each half of the combination is driven by an independent engine. Some years ago the Fairey Aviation

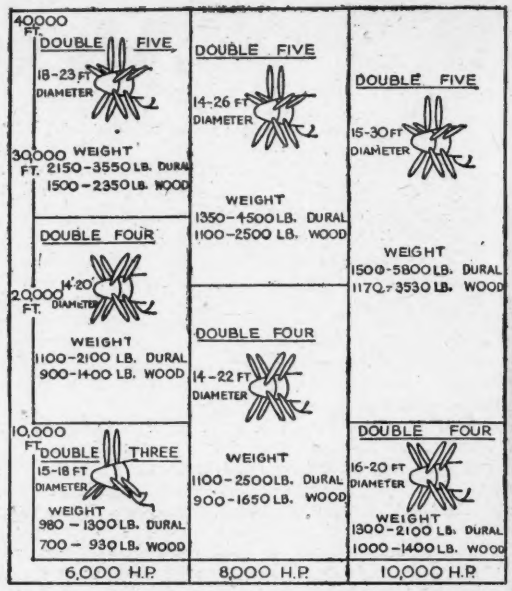
AIRSCREWS

Co. was developing an engine of this type, and it seems a pity that it was not encouraged officially. Mr. Fairhurst pointed out the safety advantage of this arrangement that in case one engine stopped, the other continued to drive its half of the airscrew. The drop in efficiency by having a feathered airscrew in front of the operating one was some 5 per cent.

Reversible-pitch airscrews have come to the fore, and Mr. Fairhurst had something to say of them also. The two major problems to be solved by the airscrew designer were the need for very high rates of pitch change (40-50 deg. per second) to avoid over-speeding the engine, and the design of blades to take care of the higher blade-root stresses caused by the negative thrust.

Many other aspects of airscrew design and construction were dealt with by Mr. Fairhurst, but space will permit of referring to one or two only. He paid a tribute to the compressed-wood blade, but thought that with speeds rising above 450 m.p.h. and demanding thinner sections manufactured to closer tolerances the wood blade would have to give way to metal. Duralumin blades would continue where the wood blade left off for high-speed fighters, and would possibly be followed by hollow or even solid steel blades. The latter would be especially suitable for super-thin sections and should make possible thickness/chord ratios of 16 per cent. at the spinner circumference.

De-icing was important because of the reduction in propulsive efficiency arising from ice accumulation, and also on account of the serious vibration set up. The ultimate solution might be the thermal method in which a resistance element on the leading edge of the blade is heated by an airscrew-driven alternator. The only drain on the aircraft batteries was of about 90 watts to give 250 watts per blade. Eventually a separate alternator, mounted on and driven by the engine, might feed current to the blade elements via slip rings.



Pictorial analysis of future airscrew types for engines from 5,000 h.p. to 10,000 h.p. If turbine units replace piston engines beyond 5,000 h.p., these weights will be on the high side.

RATIONALISING SERVICE QUALIFICATIONS

WITH the rapid demobilisation of Service aircrew personnel, the need for rationalisation of flying qualifications becomes more acute than it has ever been. A number of released R.A.F. pilots, for instance, will be hoping to obtain posts in civil aviation, yet will not expect to start, so to speak, from scratch in the obtainment of the various necessary licences.

The position has recently been somewhat clarified as far as navigational qualifications are concerned. Until now it has been possible for those in possession of R.A.F. Air Navigators' Certificates to arrange with the Ministry of Civil Aviation for exemption from parts of the civil examinations, but the right to such exemption has always been defined in terms of courses covered rather than of certificates obtained; these last have, in fact, no value, in or out of the Service, as a record of proficiency. Since the 20th of last month, however, the issue of such certificates by the R.A.F. has been discontinued, and their place has been taken by Navigation Warrants which are being awarded to past and present navigators.

These Warrants will be officially recognised in civil aviation.

R.Ae.S. LECTURE PROGRAMME

THE following lectures have been arranged by the Royal Aeronautical Society, for the present session, at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, at 6.30 p.m. A later one will be at the Institute of Civil Engineers, Great George Street, S.W.1.

October 18th.—"Aircraft Engine Oil Cooling," by F. Nixon, B.Sc., M.I.Aut.E., F.R.Ae.S.

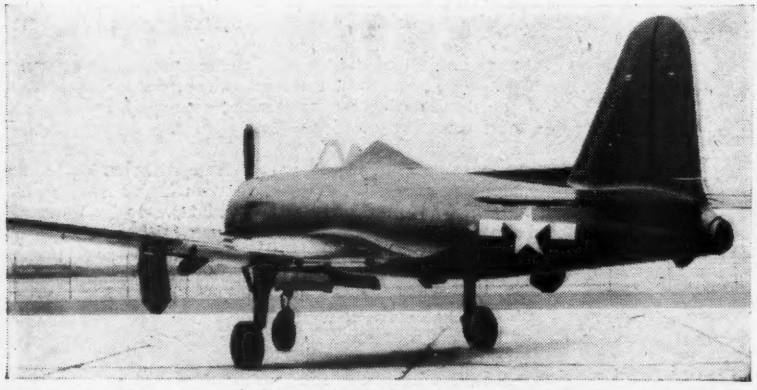
November 1st.—"A Critical Review of German Long-range Rocket Development," by W. G. A. Perring, F.R.Ae.S.

November 15th.—"Australia and Empire Air Transport," by W. Hudson Fysh, D.F.C. (First British Empire Lecture).

November 29th.—"Aspects of German Aeronautical Development," by W. J. Stern.

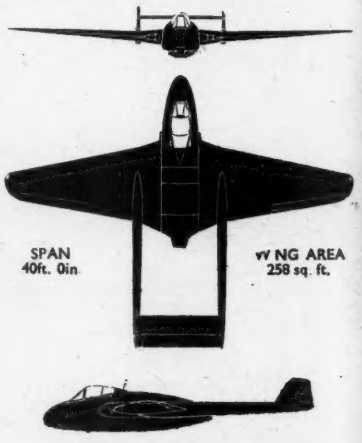
December 11th.—"Meteorology and High-altitude Aviation," by Professor Dobson, F.R.S.

Visitors will only be admitted by ticket obtainable through a member of the society.



PULL-PUSH: A rear view of the U.S. Navy's new Ryan Fireball, the FR-1, powered by both a Cyclone and a jet-propulsion unit. It is armed with four 0.5in. m.gs., carries two 1,000-lb. bombs, and can fire rockets.

D.H VAMPIRE



THE ADMIRAL GOES ABOARD

H.M. Flying Boats will play new roles in the fleets of the future—light cruisers that fly! It is an established fact that the bigger the flying boat, the better is its relative performance both as to speed and load—and, of course, the better its sea performance, too. The really big flying boat is aerodynamically at least the equal of the big landplane—but, for the work of the navy, how much more flexible.

SAUNDERS-ROE

SARO 1930

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Escape Them Never

Work of Z S M : Checking Every Ship in Every Port : Measuring Speed by Bow Waves

LONG before the invasion of Europe, Britain knew the movements of every ocean-going Nazi ship—whether naval unit, tanker or merchant vessel. Most of the names, and often even the cargoes, were known. The blockade-runners between German-held France and the Far East were beaten because the Navies of Britain and America were told when and where the enemy ships would sail.

How was it done? Largely by photographs. By a card-index system so simple that one would never guess the years of patient study behind it, and yet so fool-proof that a person who had never seen a ship in his life could use it. A system, moreover, which, with small alteration, could be switched to mirror the reviving transport of peace-time Europe.

In the R.A.F. and the Navy it was called ZSM. "Z" for the section of the Allied Central Interpretation Unit, which studied the air reconnaissance photographs taken during the war, and "SM" for Shipping Movements.

The 6,400-ton German *Munsterland*, sunk by the big guns of Dover during January, 1944, was one of the victories of ZSM. By means of photographs taken by Coastal

The result of an attack on the *Munsterland* by a Coastal Command Liberator in 1943.

The *Munsterland* resting on the sea-bed off Cap Gris Nez after being sunk by our coastal guns in January, 1944

Command patrol and reconnaissance aircraft, they watched her finish a run from the Far East and reach Bordeaux in May, 1942. In the Bay of Biscay she was attacked and damaged, and had to have an extensive refit. The British experts watched her undergoing repairs at Nantes and in a floating dock near Bordeaux. When, in October, 1934, she moved up the French coast towards the Channel, ZSM passed the word she was in Cherbourg. There Fighter Command aircraft attacked her, and again she had to go into dock for repairs.

From Cherbourg, seaworthy again, the *Munsterland* moved to Dieppe, then to Boulogne. Each move was recorded by the cameras of the R.A.F., and on the card-index at ZSM a few more lines appeared. On the night of January 20th, 1944, the *Munsterland* tried to run the gauntlet of the Straits of Dover. She was spotted sneaking through the darkness, and from the information of ZSM it was known what the target was. The guns opened up, and the *Munsterland* was hit and beached. Next day Typhoons gave her the *coup de grâce*.

Recognition Problem

At the beginning of the war the R.A.F. had very few men capable of identifying shipping from photographs. All the standard reference books gave illustrations showing the vessels from the side, not from above. Ironically, it was German shipping books that were the biggest help at first. To-day ZSM has no need for books. Their own records are in themselves the best reference.

The reports in those early days were not helpful, sometimes the reverse. One day a pilot brought in some photographs of a port area which caused a stir. The officers studying the photographs reported a number of curious dock installations which they had never seen in any enemy port before. They were large and it was felt they might be important. The mystery was not solved until someone realised it was the dock gantries of Southampton which had been photographed by mistake! The interpreters were familiar with German installations, but had never before seen our own from the air.

In the summer of 1942 a period of exceptionally fine weather settled over Europe. In the course of a few days almost every enemy port was photographed by R.A.F. reconnaissance aircraft. It was the chance the interpreters had been waiting for; they worked now in the sure knowledge that the tanker they had seen in Kiel, for example, could not possibly be the same one as they had seen at Bordeaux in a photograph the day before. It could not get there in time.

So for many weeks they pored over the picture of each port, measuring, checking, looking up references, stock-

taking the whole German merchant marine, as well as the ships of other nations that the enemy was using. The result of that work was a master-list of ships and photographs, the foundation upon which the structure of ZSM was built. Two tiny photographs of each ship were cut out and stuck on a card the right distance apart for the stereoscope, the optical instrument that makes the picture stand out in sharp relief. On the card went all the information available—a potted history of each ship. As better photographs and later information was received, they were added to the original card. It was from those little fragments of pictures, each hardly half an inch long, that ZSM was able to hunt down the enemy merchant fleet.

Until the actual names of each ship became definitely known a system of letters was used—"M" for merchant ships, "T" for tanker, "L" for liner, and so on. If the Navy were told that L24 was about to sail, for example, wires hummed and radio crackled with orders; a big enemy passenger ship might be taken or sunk.

Getting Their Measure

The system used for identifying ships was based on their length and other characteristic features. If the ship was at sea, the length had to be measured with slide-rule and dividers, and the number of feet worked out from the height of the aircraft when the picture was taken and the focal length of the camera. At first even ships in harbour had to be measured in the same way, unless there was a building or some other object of known length with which the ship could be compared. Later on, when the exact length of ship after ship was found and recorded, new ships were photographed alongside the ones already measured, and by comparison the interpreters could get the length of the unknown vessel to within a few feet.

Once he had measured the length, the interpreter simply looked up the card index of all vessels of the selected length or near it, rejected all those showing different features, such as bridge, funnels or masts, checked any other details such as armament, and then compared the picture under examination with the remaining pictures in the card index. Usually there was one that tallied exactly. If not, further examination showed whether one of the known ships had been altered, or whether a vessel not previously photographed had to be added to the list.

In time the interpreters became so familiar with the larger German ships that they were able to recognise them at once without looking at the index at all. They knew normal life in the enemy ports as well as they knew the lines on their own hands.

From observation of the enemy ports they found the fixed routine at the blockade-running bases to be in the following stages:—

(1) Dockyard for overhaul. (2) Dry dock. (3) Dockyard again for adjustments. (4) Quay for loading. (5) Lie-off awaiting departure. (6) Departure.

Knowing from the photographs exactly which stage a ship had reached, they could forecast accurately when she would sail.

Another development was the estimation of the speed of a ship, and from that a record of its probable performance. This was done from measurement of the bow waves sent out as the ship cut through the water. Simply by looking at the half-inch picture the interpreter could tell the name, size, tonnage, port of departure, armament and the history of the ship, besides many other details.

There were, of course, limits to the scope of the study. Unless of special importance, vessels of under 2,500 tons were not recorded. The scale of photographs was so small that the margin of error in measurement was too wide, and the time taken to study each small photograph was not considered justified.

But the real concern of the Admiralty was the ocean-going ships, and these ZSM faithfully recorded. Once the system had been established, 95 per cent. of the ships photographed could be identified with absolute certainty. Reports were issued on every port photographed, sometimes as many as ten a day. These reports were, in a sense, the barometer of the Allied blockade. From them the Ministry of Economic Warfare could tell how much material the enemy was getting in and out of Europe.

When the Allied invasion began the system was extended to the Continental railways. A new section was set up to study this aspect alone. Germany was divided into four huge segments, and to each junction and every stretch of railway was allotted a code letter and number. If ZR ("R" for Railways) reported a military train on line GA127 the bombers knew they had a target at a point between Hamburg and Bremen.

Military trains were easy to recognise, an example of the oft-quoted methodical mind of the Hun. The same types of train were always the same pattern—flat trucks, box cars, and then flat trucks again. Even if no tanks or guns peeped from the tarpaulins the interpreter knew what was likely to be underneath.

Dossiers were kept of every marshalling yard—a particularly fat one for Hamm, of 1940-41 fame. When the Allied attack on the railways began the bombers went out armed with fullest information on where their attack would do most harm. They were so successful that ZR was almost swamped with information on shattered lines, blocked traffic, diversions and stoppages caused by the raids. Daily reports, sometimes 60 pages in length, were produced, a memorable one recording that more than half the entire German railways system had been smashed in a month.

The enemy could not stay the pace. Finally all railway movement by day ceased, and he moved his trucks stealthily by night, along single lines and side tracks.

But even then they could not escape. As with the ships, so with the trains. The photographic aircraft in the air, the photographic interpreters on the ground, spied them out and tracked them down until the whole German transport system cracked and crumbled in the last onslaught before the end.

A.T.C. GLIDING DEVELOPMENTS

NEW developments in the peacetime training programme of the A.T.C. include the introduction of two-seater gliders for cadet training, and provision of living accommodation at gliding schools. Only a few two-seater gliders have been available in the past, and these were used mainly for training instructors in high altitude gliding and stages of gliding not taught to cadets. Under the new programme a substantial number of two-seater gliders of the most modern type will be used in addition to the standard single-seat types.

Initial orders for the new gliders have already been placed, and it is expected that first deliveries will be reaching the Corps in good time for an intensive gliding "drive" next spring. In addition, more than 100 standard type single-seat "cadet" gliders will be added to the existing "first-line fleet" of over 300 modern gliders already in use at A.T.C. elementary gliding schools.

The accommodation, which is being provided, is at certain A.T.C. gliding schools located elsewhere than on R.A.F. stations, where messing and sleeping facilities already exist and where some cadets have already spent periods up to a week undergoing full-time gliding training. By accommodating the cadets on the spot, their gliding instruction can be continuous, in the same way as R.A.F. flying training, instead of at infrequent intervals. This has led to a pronounced improvement in the standard of gliding proficiency reached, as well as effecting a considerable saving of time.

To enable the new gliding programme to be carried out, nearly 200 additional A.T.C. officers, all of whom give their services voluntarily, will be trained as instructors. Special new travelling concessions have been authorised, and will help cadets from outlying districts who have found it difficult to get to the A.T.C. gliding schools.

The new concessions will not only speed up gliding training, but will mean that a larger proportion of the Corps' 100,000 cadets will, in the future, be able to learn the elements of gliding, which is being increasingly recognised as a valuable basic training for power flying as well as one of the most popular features of A.T.C. activities.

VIP

Flying Conference Room

The illustration shows a typical Rumbold idea—the flying conference room for use in flight or on the ground. In an aircraft so equipped, there would also be state-rooms, smoke-room, galley and full toilet facilities.

In war, air transport has been the servant of Statesmanship. In the new era of peace, Commerce will follow the example set by those who brought victory to the Allied Arms. Men on whom reconstruction depends will accomplish their tasks quicker, more surely, by using the air—modern means of travel.

Rumbold, acknowledged world-authority on comfort engineering is ready with schemes for the furnishing, decoration and equipment of the aircraft which will carry the leaders of Industry and Trade smoothly and quickly on their peaceful pursuits to the ends of the Earth.

All the skill, ingenuity and amassed experience which helped Rumbold to shoulder responsibility for furniture, decorations, sound insulation, thermal control, ventilation, plumbing and vibration-cancelling of the aircraft used by British and American war leaders is now available to aircraft manufacturers and operators considering comfort problems.

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de Havilland Dove

The prototype Dove coming in after its first flight at Hatfield.

First Details of Latest D.H. Civil Type : High Efficiency and Low Operating Costs

THE aviation world as a whole has undoubtedly been waiting with a certain amount of impatience for comprehensive details of the de Havilland Dove, but the company have pursued the very sensible policy of not publicising anything other than the most elementary features of the new aircraft until such time as the prototype had flown. That event having taken place, a factual and adduced appraisal of the machine is now possible.

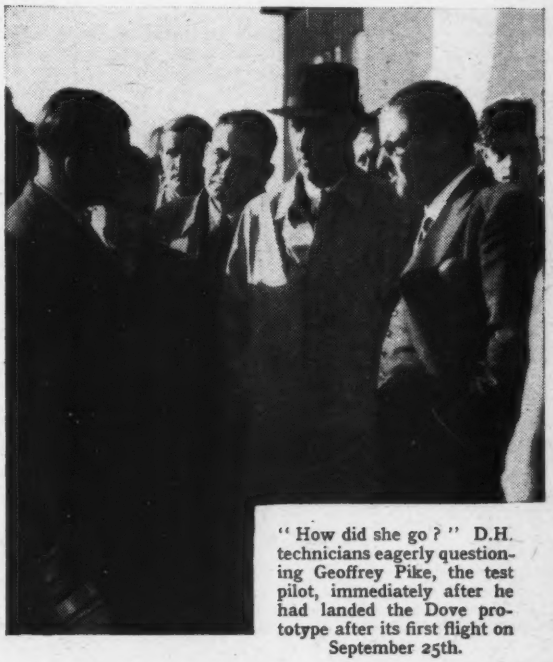
It has frequently been suggested that the Dove has a strong physical resemblance to its military brother the Mosquito, but although it is probably true to say that many of the features have that indefinable D.H. stamp, in point of fact the Dove is not very much like the Mosquito in appearance although it certainly has that aircraft's excellent characteristics of aerodynamic cleanliness.

The aircraft has specifically been designed to serve developed or developing feeder lines which, for reasons of frequency, stage length or traffic volume, have the necessity for small machines seating from eight to eleven passengers and can rely upon 800 to 1,000 hours of work per annum at loadings averaging a minimum of one-half to two-thirds full capacity. For air services which have that minimum level of traffic and do not require a larger machine, the Dove should be probably the most economical aircraft available for some years to come.

Comparison with Dragon Rapide

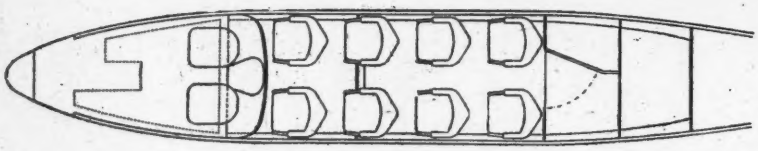
In compiling their statistical information on the aircraft the makers have linked it up with its famous predecessor the Dragon Rapide, their reason for doing this being that where reasonably full traffic densities do not obtain (for instance, a lone operator working very light traffic with a small fleet) an aircraft of more rudimentary design such as the Dragon Rapide would turn out to be a better investment in the majority of cases. For this reason the performance curves given provide a comparison between the two aircraft. Briefly, the results can be summarised to show that the Dove carries about 1½ times the payload with the same range as the Dragon Rapide, at 1¼ times the speed for approximately similar fuel consumption per aircraft mile. The Dove is, of course, the larger aircraft and is more expensive to build and will, therefore, always cost more to operate per aircraft hour or aircraft mile, although the amount would naturally be reduced as utilisation increases. However, as it carries more load at higher speed for the same fuel consumption, it will always cost less per ton mile of payload, whilst at the same time having the advantages of superior speed, better single-engine performance and various other features.

This is true for utilisation levels as low as 1,000 hours a year or even lower assuming fleet operating conditions and capacity loading. It must be remembered that the



"How did she go?" D.H. technicians eagerly questioning Geoffrey Pike, the test pilot, immediately after he had landed the Dove prototype after its first flight on September 25th.

DE HAVILLAND DOVE



In the interests of economy and aerodynamic efficiency there is the minimum of waste space in the Dove cabin layout.

higher speed alone means an increase of traffic turnover per hour and, in certain cases, makes possible the completion of additional stages.

The de Havilland Company has shown a very praiseworthy sense of values in so quickly getting down to the job of making available a really efficient and very useful aircraft which should prove extremely popular not only in this country but all over the world, and therefore help in enhancing this country's much-needed export trade.

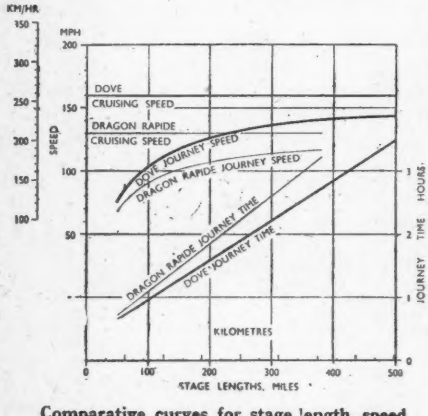
In size and power the Dove is admirably balanced for its designed sphere of use. Its size is such as to make it especially useful for charter work, executive travel and private ownership, in addition to its obvious suitability for feeder-airline operation. Versatility has been designed into the aircraft so that, although nominally the basic machine is an eight-seater with luggage compartments of 22 cu. ft. forward and 45 cu. ft. aft, by removing the detachable internal bulkheads and eliminating the toilet compartment ten passengers can be accommodated, or, by additionally removing the rear luggage compartment eleven passengers may be carried; even in this latter case there still remains the forward luggage hold beneath the cockpit floor. Alternatively, with all seats removed a cabin volume of 348 cu. ft. is available for the carriage of freight; further, although the door width and position is eminently suitable for ordinary operation it is equally fitting for ambulance duty. On the other hand, the Dove is well suited for air survey work, and is readily convertible for float or ski landing gear.

The fuselage sides are parallel throughout the length of the cabin, the internal width of which is 4ft. 6in. and the height 5ft. 2¼in. throughout. Windows are very generous in area and are conveniently located both in pitch and in height for the seats. Further, as the windows are separated by narrow pillars there is an excellent sense of lightness in the cabin. Psychologically this is quite an important feature, and anything that is advantageous in minimising the effect of being confined in a small cabin is very well worthy of the most detailed attention on the part of the designer. If the ordinary public are to be induced to accept air transport on anything like the same basis that surface transport is accepted every single item that is contributory to a sense of content or serenity should be given high priority from the very start of a machine's design. On this basis the Dove is worthy of high marks, for although the cabin is actually of small proportions there is no mental impression of being cramped or confined; in fact, the contrary obtains. The cabin is, in addition, well ventilated, hot or cold air being admitted under control by the pilot.

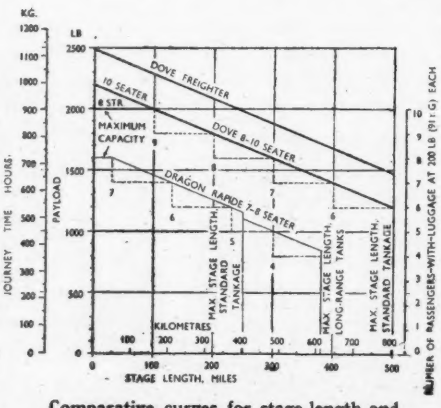
The Dove is a very "eyeable" aircraft and the modern manner of carrying the fin forward up the spine of the fuselage does not appear obtrusive.

The fuselage has a deep oval cross section and is of monocoque construction with three main longerons riveted to the skin on each side of the cabin portion of the fuselage, two above and one below the window line. The centre section spar is a built-up box section which is integral with the fuselage structure, and although the spar actually forms an obstruction across the lower portion of the cabin, it does not project very much above the floor and is rendered the less inconvenient by passing beneath a pair of seats. Main wing pick-up points are located on the centre section spar at the fuselage sides.

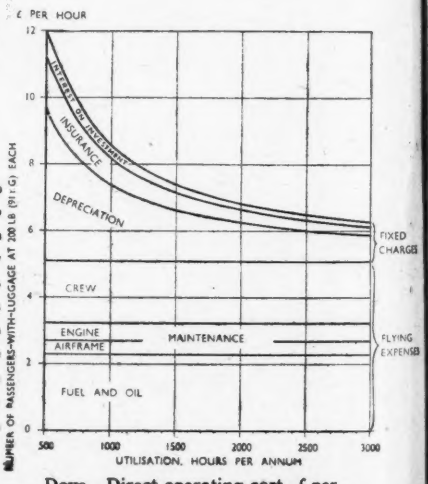
Wings are quite orthodox in construction and have an I-section main spar with a built-up light alloy false-spar to carry the flaps and ailerons. Forward of the main spar from the fuselage side to outboard of each engine is another false spar to which the engine bearers are attached. Top and bottom wing surface skins are light alloy sheets of varying thicknesses on spanwise stringers and are riveted to the spars and ribs. Ailerons and



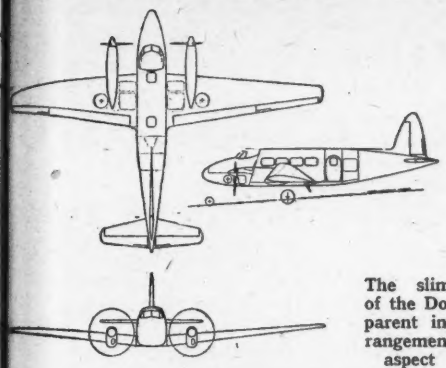
Comparative curves for stage length, speed and time.



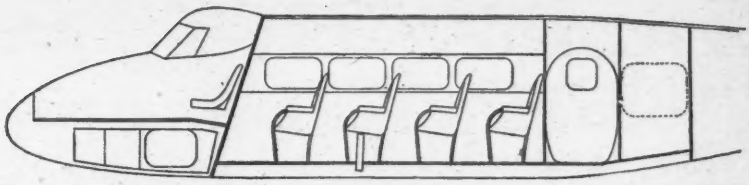
Comparative curves for stage length and payload



Dove. Direct operating cost £ per aircraft flying hour.



The slim graceful lines of the Dove are clearly apparent in this general arrangement. The clean frontal aspect being marked.



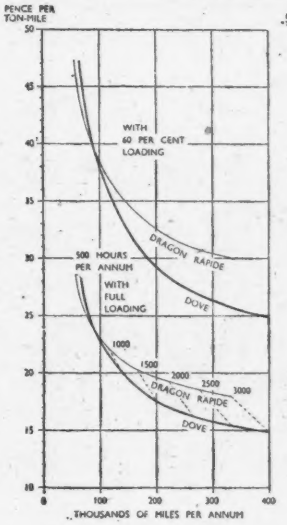
There is ample room for luggage beneath the pilot's floor and over twice this amount in the aft compartment. The arrangement of the spar to cause the least inconvenience in the cabin is ingenious.

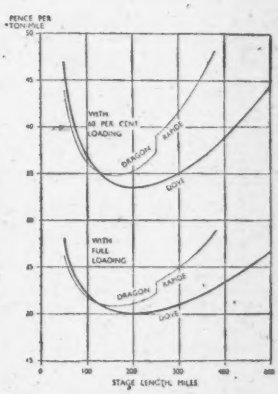
PERFORMANCE (Loaded to 8,000 lb.)

Maximum level speed	218 m.p.h.
Altitude for maximum level speed	7,200ft.
Recommended continuous cruising speed at :—	
Sea level	150 m.p.h.
5,000ft.	160 m.p.h.
10,000ft.	170 m.p.h.
Maximum cruising altitude	13,000ft.
Rate of climb at sea level (using normal climb power)	850 ft./min.
Service ceiling (where the rate of climb is 100 ft/min.)	21,500ft.
Take-off :—Distance to 50ft. in still air :—	
(1) At sea level (on grass surface)	500 yd.
(2) At 6,000ft. and 23°C. atmospheric temperature (20° C. above standard) (on grass)	700 yd.
(3) At sea level, on a hard runway, if one engine fails when commencing to climb	1,230 yd.
Landing :—	
Distance from 50ft. in still air, at sea level	500 yd
Performance on one engine (using normal climb power, with opposite airscrew feathered). Rate of climb	120 ft./min. up to 7,000ft.
Absolute ceiling	10,000ft.

CRUISING at 5,000ft.

Proportion of take-off power.	Cruising speed.	Miles/gall.	Payload with 500 miles still-air range.	Range with 1,700 lb. payload.
	m.p.h.		lb.	miles
0.75	194	6.0	1,575	395
0.66	184	6.4	1,615	420
0.47	160	7.6	1,700	500





(Above) Direct operating cost, pence per ton-mile. Assumed utilisation 1,000 hours per annum.

(Left) Direct operating cost, pence per ton-mile.

ENGINE DATA

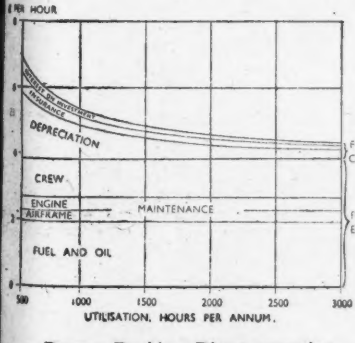
Two de Havilland Gipsy Queen 71 engines: inverted air-cooled six-cylinder, in-line, geared and supercharged.
Power outputs (per engine):
Take-off and emergencies—330 B.H.P. at sea level, rising to 344 B.H.P. at 4,000ft.
All-out level—305 B.H.P. at 6,200ft.
Continuous climb (used for one-engine flight)—285 B.H.P. at 7,000ft.
Maximum weak-mixture cruising—252 B.H.P. at 6,600ft.
Recommended continuous cruising (for long overhaul periods)—
150 B.H.P. at sea level, rising to 170 B.H.P. at 12,000ft.

flaps are fabric covered, the latter being pneumatically operated. The tailplane and fin are metal covered units of conventional design, whilst elevators and rudder are fabric-covered surfaces.

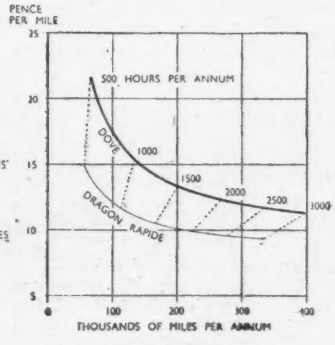
Engines are the latest de Havilland Gipsy units bearing the designation Gipsy Queen 71 and drive de Havilland Hydromatic constant-speed feathering and braking airscrews. Power plants are interchangeable port and starboard and are so arranged that one power plant complete with oil tank and oil cooler can be changed and replaced in less than two hours in the field. An oil dilution system for easy starting in Arctic conditions is incorporated, and priming is by a Ki-gass pump in the cockpit. The fuel system incorporates two three-way cocks and two fuel filters which are so arranged that either (i) the two pairs of tanks alone feed their respective engines, or (ii) either engine can be cross feed from either pair of tanks, thus all the available fuel may be used in any condition.

Each unit of the tricycle undercarriage is pneumatically retracted and the shock absorption system is a development of that inaugurated in the Mosquito, the shock absorber units being of the rubber-compression type. Main legs are interchangeable port and starboard and incorporate radius-rod components common to all three wheels. The nose wheel is fully castoring and is automatically self-centring for retraction; its tyre is a Marstrand double-track type. Emergency lowering of the undercarriage is by mechanical means.

There are no hydraulics in the Dove, the only power services being electric and pneumatic. Electricity is supplied from two 24-volt, 750 watt engine-driven generators feeding two 12-volt



Dragon Rapide. Direct operating cost £ per aircraft flying hour.



Direct operating cost, pence per aircraft mile.

DIMENSIONS

Gross wing area	335 sq. ft.
Span	57ft.
Overall length	39ft. 4in.
Overall height—over rudder	13ft.
Height to top of engine nacelle	5 t. 9in.
Door and floor level height	2ft. 3in.
Clearance under fuselage	1ft. 9in
Track—to centre line of wheels	13ft. 9in
Overall width of undercarriage	14ft. 7in.

LOADINGS

Span	2.46 lb./sq. ft.
Wing	23.9 lb./sq. ft.
Power (take-off)	12.1 lb./B.H.P.

DE HAVILLAND DOVE

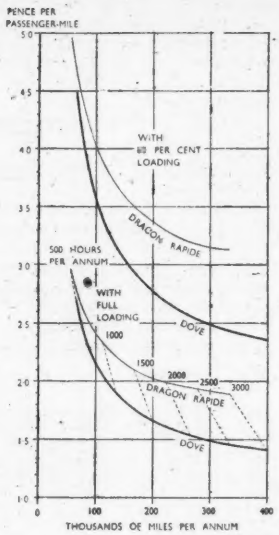
DIRECT OPERATING COST PER AIRCRAFT FLYING HOUR

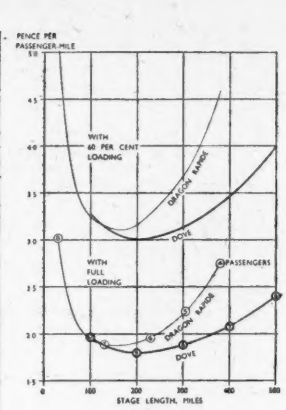
Hourly Flying Expenses.	Dove. Cost per flying hour.	Dragon Rapide. Cost per flying hour.
Fuel and Oil :—An average allowance is made to take account of the additional fuel used in taxying, take-off, etc.	£2.31	£1.98
Maintenance :—(a) Airframe. £1.25 per aircraft flying hour per 10,000 lb. of airframe weight	£0.43	£0.31
(b) Engine. £1.5 per aircraft flying hour per 1,000 cruising B.H.P.	£0.48 — £0.91	£0.39 — £0.70
Crew :—Captain—salary, £850 per annum. Radio operator—salary £550 per annum. Insurance and expenses—0.15 of salary. Flying time per annum—850 hours.		
£ per aircraft flying hour = $\frac{£850 \times 1.15}{850}$	£1.15	£1.15
$= \frac{£550 \times 1.15}{850}$	£0.74 — £1.89	— £1.15
Total hourly flying expenses	£5.11	£3.83

FIXED CHARGES

	Dove Cost per flying hour.	Dragon Rapide Cost per flying hour.
Depreciation :—Five years' life with 0.25 residual value at end, giving £150 per £1,000 of aircraft cost with spares cost, divided by the total flying hours per annum	£2.25	£0.99
Insurance :—0.08 per annum of the average insured value of the aircraft (taken as 0.70 of the first cost) to include both comprehensive and third-party cover, giving £56 per £1,000 of aircraft first cost, divided by the total flying hours per annum	£0.70	£0.31
Interest on Investment :—0.05 per annum on the average value of the investment (taken as 0.70 of the first cost of the aircraft with spares) giving £35 per £1,000 of aircraft first cost divided by the total flying hours per annum	£0.52	£0.23
Total fixed charges	£3.47	£1.53
Direct operating cost per aircraft flying hour (sum of hourly flying expenses and fixed charges)	£8.58	£5.36

This example assumes a utilisation of 1,000 hours per annum.





(Left)
Pence per passenger mile.

(Above)
Pence per passenger mile.

WEIGHTS

	Standard 8-passenger version.	Standard version without seats and toilet	With no sound-proofing or upholstery.
	lb.	lb.	lb.
Tare weight	5,238	5,103	4,963
Radio	100	100	100
Crew of two	360	360	360
Fuel, 71 galls., for 500 miles still air range	512	512	512
Oil, 10 galls.	90	90	90
Payload	1,700	1,835	1,975
All-up weight... ...	8,000	8,000	8,000

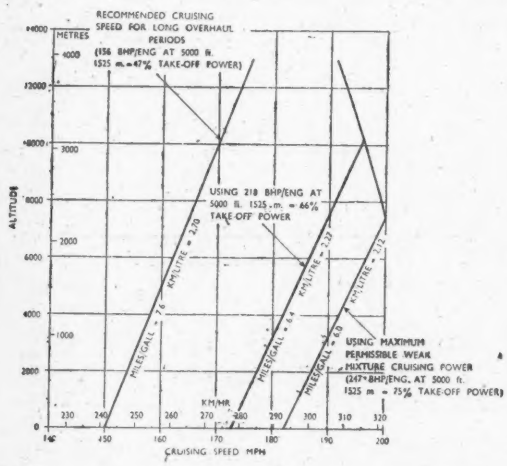
ASSUMPTIONS

	Dove.	Dragon Rapide
Cruising fuel consumption, gall./hr. ...	21	18
Cost of fuel per gall.	2/-	2/-
Cost of oil	0.06 of fuel cost per hr.	0.06 of fuel cost per hr.
Air frame weight, lb.	3,430	2,500
Total cruising B.H.P.	320	260
Crew	2	1
First cost of aircraft (estimated)	£12,500	£5,500
Spares carried	0.20 of first cost of aircraft.	0.20 of first cost of aircraft.

accumulators, whilst the pneumatic supply is from duplicated air bottles maintained by duplicated Heywood compressors at a maximum pressure of 600 lb/sq. in. for operation of the undercarriage, flaps and wheel brakes.

General performance of the Dove is excellent, but importance has been attached to single-engine performance and the latest requirements of the Air Registration Board are fulfilled.

On full load the machine will climb to 7,000ft. at a rate of 120ft. per minute on one engine at normal climbing power, and the absolute ceiling in that condition with full load is 10,000ft. Additionally, if when taking off one engine should fail at the moment of starting to climb the aircraft will continue climbing and will attain a height of 50ft. within 1,230 yards of the start of the take-off run; alternatively, the Dove can be landed and brought to rest in less than that distance.


RECOMMENDED CRUISING SPEED FOR LONG OVERHAUL PERIODS (156 BHP/ENG AT 5000 ft. 1525 m. = 47% TAKE-OFF POWER)
METRES
ALTITUDE
USING 218 BHP/ENG AT 5000 ft. 1525 m. = 66% TAKE OFF POWER
MILES/GALL = 1.6
KM/LITRE = 2.30
MILES/GALL = 1.4
KM/LITRE = 2.01
MILES/GALL = 1.18
KM/LITRE = 1.72
USING MAXIMUM PERMISSIBLE WEAK MIXTURE CRUISING POWER (247 BHP/ENG. AT 5000 ft. 1525 m = 75% TAKE-OFF POWER)
KM/HR
CRUISING SPEED MPH

Variation of cruising speed with altitude and power.

It is noteworthy that the de Havilland airscrews are equipped for negative thrust braking which not only reduces the landing distance considerably and so spare the wheel brakes for the relatively light duty of ground manœuvring, but also provides very useful advantage for emergency landings or alighting on very short airfields.

Because costs vary widely between different countries and for different operating conditions and changing price levels, it is very difficult to give an overall and accurate guide to the cost of operating a particular type. The aircraft manufacturer can, however, supply a good deal of the data for costing an aircraft, but he is obliged to make assumptions for other items such as maintenance, salaries, price of fuel, etc., so that, although the cost calculations estimated by de Havillands and reproduced here are unlikely to fit an actual case, they should serve as a useful guide if the individual operator can readily substitute specific figures. Only direct operating costs are being considered, administration, road transport, plant and buildings, and all other indirect costs being excluded. The figures are based on British price levels obtaining early in 1945 and adjustments should be made accordingly. As mentioned, because the province of the Dove is so near that of the well-proved Dragon Rapide, it has been thought desirable by the makers to show figures for the two types side by side.

Early History of the Whittle Jet Propulsion Gas Turbine*

By AIR COMMODORE FRANK WHITTLE, C.B.E., R.A.F., M.A., Hon. M.I.Mech.E.

THE paper was prefaced by the author with a quotation from Francis Bacon. "I do not endeavour either by triumphs of confutation or pleadings of antiquity, or assumption of authority, or even by the veil of obscurity, to invest these inventions of mine with any majesty . . . ." Generous tribute was also paid to the work of his collaborators and assistants. Such actions are characteristic of Air Commodore Frank Whittle. They add to, rather than detract from, the personal brilliance of his achievement. He sensed that the time was ripe for the change from reciprocating to rotating power units for aircraft. He conceived the practical means of developing the gas turbine for jet propulsion, he possessed the knowledge and consummate skill to design the new project, and the perseverance to carry it through to success. In the engineering world he will rank with the great men whose names are permanently associated with some epochal advance in technique.

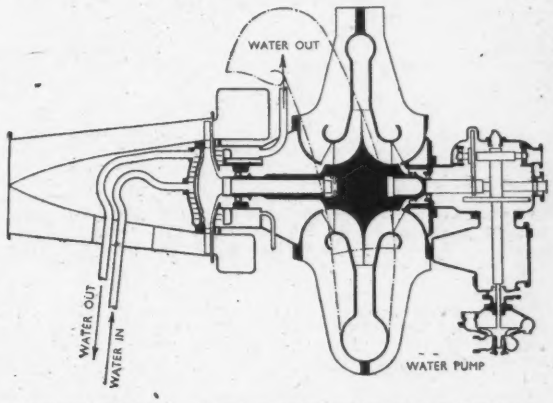
THERE have been many attempts to solve the gas-turbine problem in the past. The records in the Patent Office would probably show that the problem of the gas turbine has engaged the attention of inventors almost to the same extent as perpetual motion. It will suffice to say that the constant-pressure gas turbine is an old idea, and that there have been many attempts to produce a practicable engine of this sort, but at the time I started thinking about the subject, i.e., in 1928, the many failures had led to a general belief in the engineering world that it had no future.

The main argument against the gas turbine was that the maximum temperatures permissible with materials available, or likely to be available, was such that the ratio of positive to negative work in the constant-pressure cycle could not be great enough to allow of a reasonable margin of useful work to be obtained, after allowing for the losses in the turbine and compressor. There seemed to be a curious tendency to take it for granted that the low efficiencies of turbines and compressors commonly cited were inevitable. I did not share the prevalent pessimism because I was convinced that big improvements in these efficiencies were possible, and, in the application of jet propulsion to aircraft, I realised that there were certain favourable factors not present in other applications, namely:—

(1) The fact that the low temperatures at high altitudes made possible a greater ratio of positive to negative work for a given maximum cycle temperature.

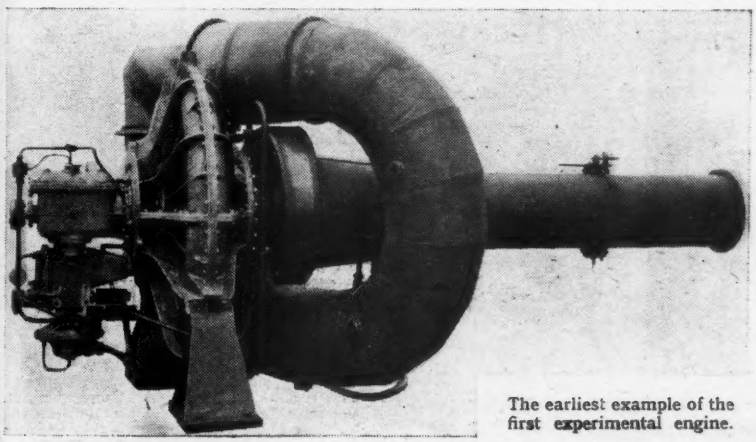
(2) A certain proportion of the compression could be obtained at high efficiency by the ram effect of forward speed, thereby raising the average efficiency of the whole compression process.

(3) The expansion taking place in the turbine element of such an engine was only that which was necessary to drive the compressor; and therefore only part of the expansion process was subject to turbine losses.



Sectional diagram of first experimental engine with single combustion chamber and water-cooled turbine.

I first started thinking about this general subject in 1928, in my fourth term as a Flight Cadet at the R.A.F. College, Cranwell. Each term we had to write a science thesis, and in my fourth term I chose for my subject the future developments of aircraft. Amongst other things, I discussed the possibilities of jet propulsion and of gas turbines; but it was not until eighteen months later, when on an Instructors' Course at the Central Flying School, Wittering, that I conceived the idea of using a gas turbine *for* jet propulsion. I applied for my first patent in January, 1930.†



The earliest example of the first experimental engine.

The idea was submitted to the Air Ministry, but was turned down on the ground that as it was a gas turbine the practical difficulties in the way of the development were too great. During 1930 I tried to interest various firms in the scheme, but met with no success; for the most part they thought the same way as the Air Ministry.

Nothing very much happened for a few years. I gave up hope of ever getting the idea to the practical stage, but continued to do paper work at intervals until, in May, 1935, when I was at Cambridge as an Engineer Officer taking the Tripos Course, I was approached by two ex-R.A.F. officers (Mr. R. D. Williams

* Abstracted from the first James Clayton Lecture delivered to the Institution of Mechanical Engineers on 5th October, 1945.

† The specification and drawings have already appeared in *Flight* and in the book "Gas Turbines and Jet Propulsion of Aircraft" by G. Geoffrey Smith.

EARLY HISTORY OF THE WHITTLE JET PROPULSION GAS TURBINE

and Mr. J. C. B. Tinling), who suggested that they should try to get something started. Though I had allowed the original patent to lapse through failure to pay the renewal fee, I agreed to co-operate.

We eventually succeeded in coming to an arrangement with a firm of investment bankers (Messrs. O. T. Falk and Partners), which led to the formation of Power Jets, Ltd., in March, 1936. The President of the Air Council was a party to the agreement which resulted in the formation of Power Jets, and the Air Ministry was a shareholder from the start in that a proportion of the shares allotted to me was held in trust for the Department. Power Jets placed the order for the manufacture of the engine (except the combustion chamber, instruments, and some accessories) with the British Thomson-Houston Company in June, 1936.

The engine was to be a simple jet propulsion gas turbine having a single-stage centrifugal compressor with bilateral intakes, driven by a single-stage turbine directly coupled. Combustion was to take place in a single combustion chamber through which the working fluid passed from the compressor to the turbine.

We were going beyond all previous engineering experience in each of the major organs. We were aiming at a pressure ratio of about 4:1 in a single-stage centrifugal blower when at the time, so far as we knew, a ratio of 2.5:1 had not been exceeded. We were aiming at a breathing capacity in proportion to size substantially greater than had previously been attempted. The combustion intensity we aimed to achieve was far beyond anything previously attempted. Finally, we had to get over 3,000 s.h.p. out of a single-stage turbine wheel of about 16½ inches outside diameter, and to do it with high efficiency.

Early Combustion Experiments

At first our intention was to do the job stage by stage, but we very soon realised that this was likely to be a long and costly process and we decided to go for a complete engine right away. I was fairly confident in the compressor and turbine elements, but felt rather out of my depth with the combustion problem, and so (in 1936) I visited the British Industries Fair with a view to enlisting the aid of one of the oil burner firms, but the requirements I specified were considered to be far too stringent by most of them until I met Mr. Laidlaw, of Laidlaw, Drew and Company.

While the engine was in course of design and manufacture we carried out a number of combustion experiments on the premises of the British Thomson-Houston Company, with apparatus supplied by Laidlaw, Drew and Company, until we considered that we had enough information to design a combustion chamber. Power Jets therefore placed the contract for the design and manufacture of the combustion chamber with Laidlaw, Drew and Company.

By this time the Tripos Examinations at Cambridge were over, and the Air Ministry had agreed that I should stay for a post-graduate year. This was really a device to enable me to continue work on the engine, and so a considerable proportion of my time was spent at the British Thomson-Houston Company's works in Rugby.

Testing of the engine commenced on April 12th, 1937, and continued intermittently until August 23rd. These early tests made it clear that the combustion problem was by no means solved, and that the compressor performance was far below expectations. Nevertheless, they were sufficiently encouraging to show that we were on the right track. Testing was then stopped in order to carry out a major reconstruction; and once more the British Thomson-Houston Company did this work for Power Jets.

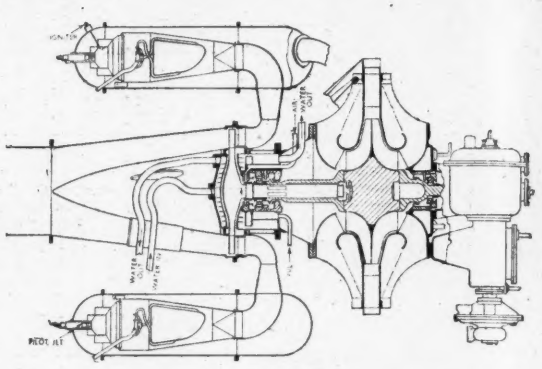
It will be of interest to explain the basis on which I was working with the British Thomson-Houston Company. I was allowed virtually complete access to all parts of their turbine factory and its contributory departments, and as time passed I was given an increasingly free hand. I was provided with an office and had access at all times to Mr. F. Samuelson, M.I.Mech.E., Chief Turbine Engineer, and his successor, Mr. R. H. Collingham, M.I.Mech.E., to his staff of specialist engineers, and to the drawing office.

After the first series of tests in 1937 the Air Ministry (on the recommendation of the Aeronautical Research Committee) began to take more notice of the work and decided to place contracts with Power Jets for a report on the first series of tests and for further research running. However, the work was still regarded as "long-term research." At the same time further private money was being raised; but the total financial resources available were still very small and the work had to be done on the basis of the most stringent economy. This proved expensive in the end, because it meant that we were continually having to use parts which really ought to have been scrapped.

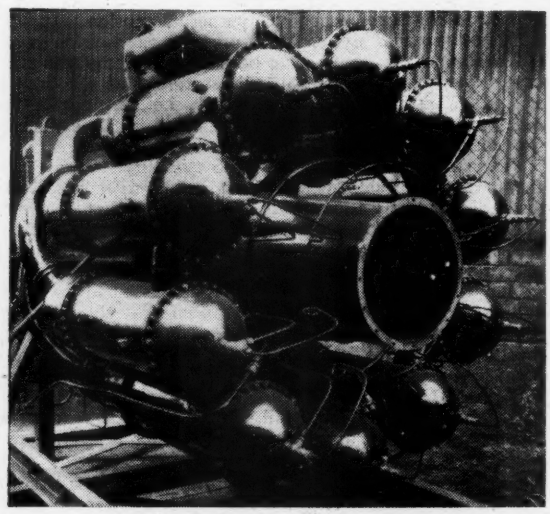
So far there had been no official secrecy requirement on the work; but secrecy was a condition of the Air Ministry contracts, and when it was imposed it naturally made the raising of private money very difficult. The Air Ministry further helped the project by placing me on the Special Duty List at the completion of my post-graduate year in the summer of 1937, to enable me to continue work on the engine on a full-time basis.

While the reconstruction of the engine was in progress we carried out another series of combustion tests until once more we thought we had solved the combustion problem.

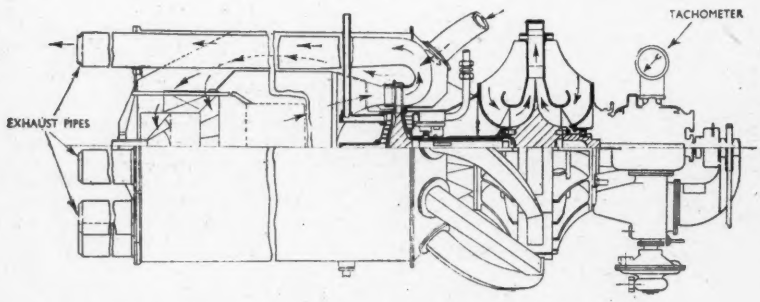
The reconstructed engine was ready to run again on April 16th, 1938, and the testing continued intermittently until May 6th, on which day the engine was severely damaged by a turbine blade failure. Though the total test running time was only about five hours, it was evident that the combustion problem



The third experimental engine had ten reverse flow combustion chambers grouped around a single axial discharge duct.

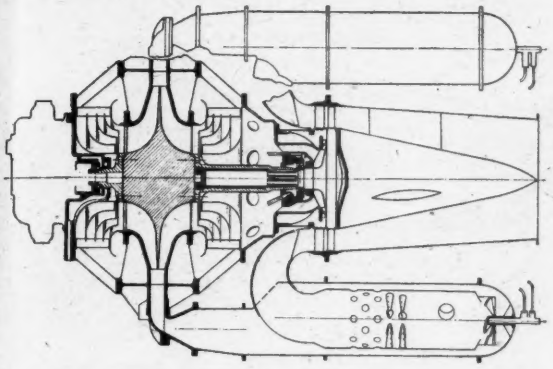


Rear view of type W1, the first flight engine.



The second experimental engine having a centrally disposed combustion chamber and a series of exhaust pipes to obtain axial symmetry.

EARLY HISTORY OF THE WHITTLE JET PROPULSION GAS TURBINE



Sectional diagram of the W2B engine with guide vanes in the compressor intakes.

was by no means solved. A second major reconstruction was decided upon, and the work was once more carried out by the British Thomson-Houston Company, but this time the Air Ministry agreed to bear the cost (by contract with Power Jets). Once more we embarked on a further series of combustion tests.

Testing of the third model of the engine commenced at the end of October, 1938, and continued intermittently until February, 1941, when it was damaged beyond repair by a turbine failure. It had by then served its purpose, and had provided an enormous amount of information on which subsequent designs were based.

Out of Research Stage

In the summer of 1939 the Air Ministry ceased to regard the development as a matter of long-term research and came to accept the fact that we had the basis of a practicable aircraft engine. As a result, Power Jets received a contract for a flight engine, July 12th, 1939, and a short time afterwards, August 30th, 1939, a contract was placed with the Gloster Aircraft Company for the manufacture of an experimental aircraft to specification E28/39. Thereafter, Power Jets and the Gloster Aircraft Company worked in close collaboration. The Ministry also agreed to purchase the experimental engine, and to cover all test running by contract.

Power Jets sub-contracted the drawing and manufacture of the flight engine, W1, with the British Thomson-Houston Company. In the course of manufacture of the W1, certain major components were considered to be unairworthy on completion, and it was decided to use these—with certain spare components made for the first experimental engine—to build an "early edition" of the W1, known as the "W1X."

Though falling short of expectations, the W1X proved to be far in advance of the experimental engine, and a number of tests were carried out on it which provided experience on which modifications to the W1 were based. The W1 was put through a 25-hours' special category test to clear it for flight. Meanwhile the E28 aircraft was completed by the Gloster Aircraft Company, and the W1X was installed in it for taxi-ing trials in April, 1941. In the course of these trials the aircraft did in fact leave the ground for a short, straight hop.

Flight trials with the W1 began on May 14th, 1941. The engine had been cleared for ten hours' flying, and the programme of flight testing laid down was completed in fourteen days without special incident. The test pilot was the late Flt. Lt. P. E. G. Sayer.

At the beginning of 1940 the Air Ministry (later the Ministry of Aircraft Production) began to work on the assumption that there was a good chance of getting jet-propelled fighter aircraft into production in time for use in the war. As a result the following steps were taken:—

(1) Power Jets were authorised to go ahead with a more advanced engine (the "W2").
(2) The Gloster Aircraft Company was authorised to proceed with the design of a twin-engined interceptor fighter (the "F9/40"—prototype of the Meteor)
(3) Direct contracts were placed with the British Thomson-Houston Company and other firms for the manufacture and development of jet propulsion gas turbines.
(4) It was decided that Power Jets should become a research and development organisation and that they were to supply all other firms engaged with all necessary drawings and any other information they needed to assist them in their work.

Modified Designs

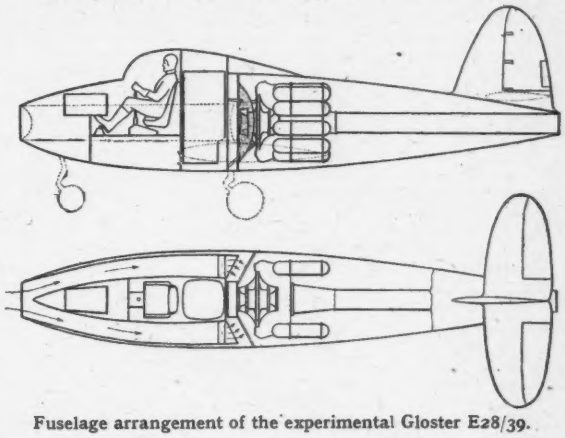
The "W1(T)" was a modified W1 built for bench development from spares.

The "W1(3)" was also a modified W1.

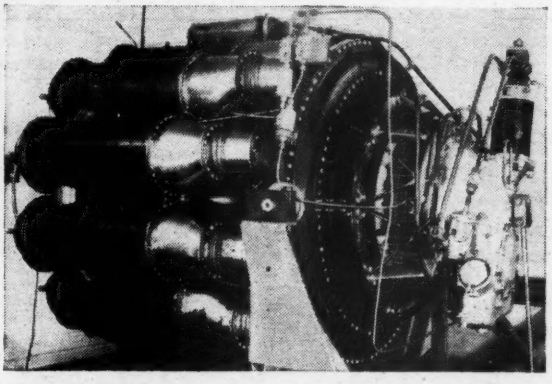
The "W1A" was an engine incorporating most of the features of the W1 but it also had in it certain of the special features of the W2 which it was desired to test in advance. This engine was manufactured by the British Thomson-Houston Company to Power Jets' requirements. (Power Jets were contractors to the Ministry of Aircraft Production.) It was flown in the E28.

Drawings of the W2 engine were handed over to the Rover Company, who made it as direct contractors to the Ministry of Aircraft Production. Powet Jets, having received a direct contract for the W2, sub-contracted the manufacture of the W2 Mk. 4 engine to the British Thomson-Houston Company. When it was realised that the design was extremely sensitive to the design assumptions, it was changed by stages to bring it nearer to that of the W2B, and when it was delivered by the sub-contractors it was further modified by Power Jets so that when testing commenced it differed only in detail from the W2B design. This engine was totally wrecked by the bursting of a faulty impeller forging, though not before a fair amount of useful testing had been done.

The "W2B" was originally designed by Power Jets, and complete sets of Power Jets' drawings were passed to the several firms by then engaged. The first and second W2Bs to be tested by Power Jets were manufactured by the Rover Company. The W2B was the prototype of the Welland engines (which subsequently powered the Meteor I in this country) and of the "Type I" (the corresponding



Fuselage arrangement of the experimental Gloster E28/39.



View of the W2B engine, the forerunner of the Rolls-Royce "Welland" and the American G.E.C. engines.

engines made by the American General Electric Company which powered the Bell Airacomet.)

By arrangement between the British and American Governments, the W1X, a set of drawings of the W2B, and a small team of Power Jets' engineers, were flown over to America in the autumn of 1941, and this initiated the intensive development of the jet-propulsion gas turbine at the General Electric Company's works at Lynn, Mass.

The whole project received a powerful stimulus from the successful flight trials of the E28. The Ministry of Aircraft Production decided to plan for production of the W2B and the Meteor. Many sceptics were converted. The firms already engaged increased their activities considerably, and other firms which had practically ignored the gas turbine suddenly evinced a lively interest.

I will conclude this outline by saying that the types of engines which trace their descent directly from the W2 and W2B have undergone continuous development, and the original design performance for that size of engine has been far exceeded.

CIVIL AVIATION

New U.S. Transports

The Unconventional DC-8 and Martin Model 202

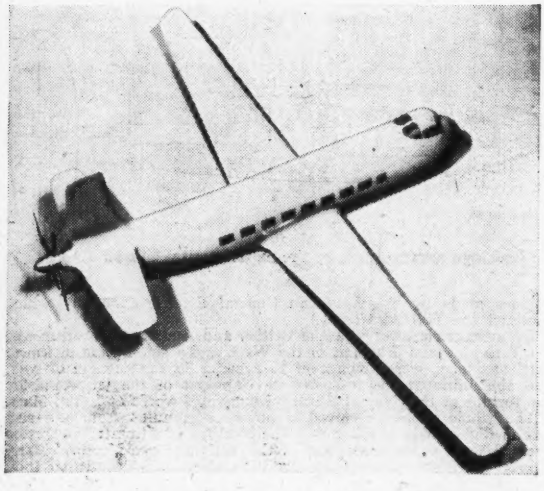
FROM across the Atlantic comes news of two new transport aircraft which, although still in the mock-up stage, are the final results of considerable development work.

The Douglas Aircraft Company announces their post-war successor to the DC-3 in the DC-8. The new commercial transport is a low-wing monoplane of 39,500 lb. gross weight and 15,585 lb. useful load, accommodating 48 passengers, mail express and general freight.

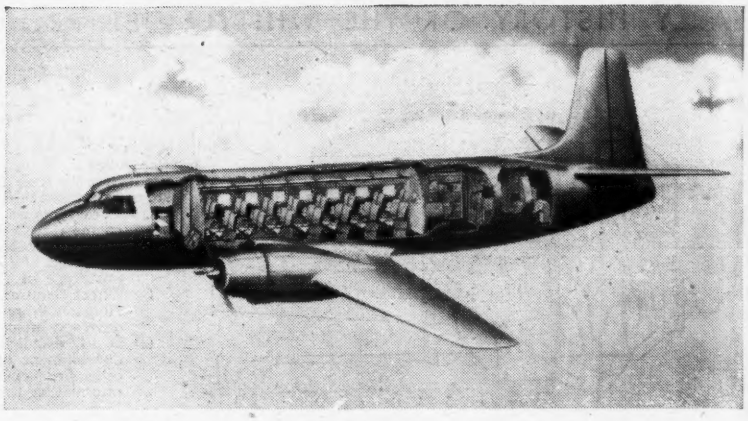
The DC-8 will be initially powered by two Allison V-1710 engines of 1,600 h.p. for take-off, mounted in the fuselage below the forward cargo compartment floor. The two engines drive through a long shaft two contra-rotating co-axial airscrews situated astern of the fuselage.

Advantages claimed for this radical departure from traditional arrangements are a greatly improved single engine performance with no off-set thrust in case of engine failure; an overall drag co-efficient 25 per cent. less than an equivalent conventional type; a higher rate of climb made possible by the 15-foot airscrews diameter, better lift distribution resulting from the higher effective wing span and the elimination of much weight from the shorter landing gear and hydraulic mechanisms. Other features claimed for the DC-8 are the considerable reduction in the cabin noise due to remote location of airscrews, improved vision from cabin windows and a cabin floor level only 60 in. above ground, allowing for easy entrance and exit.

Ease of maintenance is assured since the engine "cowlings" open like a bomb-bay door, with all maintenance items readily accessible at waist level from the ground. A cabin innovation is a movable partition which converts the DC-8 from an all-passenger to a combination passenger-freight aircraft. A freight version of the DC-8 designed to offer low operating costs per ton-mile is under development and will have a reinforced cargo floor and large loading powers fore and aft.



The DC-8 is unconventional in the extreme, with its aft contra-rotating airscrews. It has a span of 110ft. 2in., a length of 77ft. and a height of 25ft. 9in. Wing area is 1,104 sq. ft.



Martin's Model 202 has a span of 92ft. 9in. and a wing area of 860 sq. ft.

MARTIN 202

Normal Gross Weight	34,300 lb.
Manufacturer's Weight Empty	22,023 lb.
Design Useful Load	10,976 lb.
Maximum Operational Ceiling	30,000 ft.
Operational Ceiling (with one engine inoperative)	16,000 ft.
Cruising Speed at 10,000 ft. and 70 per cent. normal rated power (without jet exhaust)	270 m.p.h.
High Speed at 10,000 ft. and normal rated power (without jet exhaust)	306 m.p.h.
Stalling Speed	80 m.p.h.
Rate of Climb (Sea Level)	1,660 ft. per min.
Run for Landing at Sea Level	3,500 ft.
Run for T.O. at Sea Level (one engine inoperative)	3,750 ft.

To meet the Air Transport Association's A-1 specifications for an ideal twin-engine trunk line transport, and after 21 separate designs had been prepared, the Glenn L. Martin Co. is to produce the Model 202. This is a low-wing 30-passenger cargo transport with cruising speeds of about 270 m.p.h. for operations on main internal trunk routes. Its primary purpose is to provide low-cost transportation over ranges of 250-700 miles where large four-engined aircraft cannot be operated economically.

Two Pratt and Whitney R-2,800 2SC 15G provide a normal take-off power of 2,100 h.p., but this can be further raised to 2,400 h.p. by the optional use of water injection. A new jet-type engine exhaust system may increase cruising speeds by as much as 20 miles per hour.

The Model 202 is to be equipped with a steerable nose wheel for convenience in small airports. Reversible propellers are installed for stand-by use on shorter landing distances or icy runways.

Other interesting features of the new transport are the very large passenger and cargo doors located on opposite sides of the aircraft, which permit rapid loading and unloading of cargo and passengers at the same time. Space has been allowed under the floor of the cabin for radio, hydraulic and other accessory systems, enabling ground crews to service them easily through ample doors on the underside of the aircraft,

DC-8

WEIGHTS:	
Maximum Take-off Weight	39,500 lb.
Maximum Landing Weight	39,500 lb.
Weight Empty	23,915 lb.
Useful Load	15,585 lb.
Per cent. Useful Load/Gross Weight	39.4
ENGINES:	Allison V-1710
Take-off Power	1,600 h.p.
Max. Cruise Power, 10,000 ft.	1,025 h.p.
PERFORMANCE:	
Max. Cruise Speed, 10,000 ft.	270 m.p.h.
Max. Two-Engine Climb, S.L.	1,030 f.p.m.
10,000 ft.	840 f.p.m.
Max. One-Engine Climb, S.L.	285 f.p.m.
10,000 ft.	145 f.p.m.
Field Length, S.L., Take-off	3,950 ft.
Landing	3,960 ft.
One-Engine Operating Altitude	12,000 ft.
ECONOMY:	
Payload at 300 mi. Range	12,000 lb.
Including Passengers	48 max.
Cargo in excess of baggage (at not more than 10 lb./cu. ft.)	2,400 lb.
Block-Block Speed at 300 mi. Range (against 10 m.p.h. headwind)	223 m.p.h.
Direct Operating Cost/Aircraft Mile	41.6 c.
Direct Operating Cost/200 lb. Mile	0.695 c.

NEW U.S. TRANSPORTS

without the need for entering the cabin or other interference. These service doors have been installed on the same structural principle as bomb-bay doors on Martin bombers.

There are 525 cubic feet for luggage and cargo storage.

The passengers will sit two abreast on both sides of the aisle, in deeply upholstered, adjustable seats of a new design. The basic standard features of passenger comfort include heating and ventilating, soundproofing and indirect lighting to eliminate travel fatigue. According to the company's announcement, large-scale production of Model 202 is to begin immediately after the flight demonstration of the prototype required by the C.A.A. has been completed.

CIVIL AVIATION NEWS

TO BRAZIL

BRITISH plans for a commercial air service between this country and Brazil will materialise as soon as negotiations have been completed.

It will be the first British air route to South America, which before the war was linked up by services operated by French, German and Italian companies.

MORE AIRMAIL

AIR mail correspondence is now accepted for Holland and Poland. Air mail for Poland hitherto restricted to two ounces in weight is now permissible up to the usual four pounds limit.

LINK WITH S. AFRICA

THE first of a fleet of Avro York Transport aircraft for use on the U.K.-South Africa air route arrived in Pretoria 24 minutes ahead of schedule.

The aircraft, which had a South African crew, reached Pretoria 68 hrs. 16 mins. after leaving Hurn (Hampshire), stopping on the way at Castel Benito (near Tripoli), Cairo, Khartoum, and Nairobi.

The new service, which will be operated with Yorks until Avro Tudors are available, is scheduled to begin in the middle of November with one aircraft a week each way.

MONTREAL MEETING

DELEGATES to the Air Navigation Committee meeting in Montreal were welcomed at the opening session by Dr. Edward Warner, president of the Council of the Provisional International Civil Aviation Organisation.

Besides twenty official delegates, whose countries were elected at the Chicago Air Conference to constitute the interim council, delegates from Brazil, Switzerland, Eire, Sweden, Czechoslovakia and Spain are also attending the various committee meetings, which started on October 2nd and will continue until October 12th.

It will be recalled that the Air Navigation Committee succeeds the International Commission on Air Navigation when the Convention made at Chicago last year comes into force. Before the war the International Air Commission on Air Navigation was the only body in the world to set up rules and regulations for air navigation.

During the present meetings recommendations will be made on air navigation facilities on the high seas or in areas of undetermined sovereignty and for mutual aid in installing and maintaining navigation facilities.

SURVEY FLIGHT

THE flagship America, one of the fleet of the four-engine 40-passenger airliners with which American Export Airlines will inaugurate transatlantic landplane service between America, the United Kingdom, and Europe, landed at Bovingdon Airport, one of the scheduled stops, on a technical survey trip over international air routes certificated to the company by the U.S. Government. American Export Airlines is the overseas operating division of the American Airlines System.

The big Douglas C-54E—first American flag passenger aircraft to fly over the North Atlantic route into Northern Europe and Scandinavia—left LaGuardia Field on Tuesday, September 25th, with Capt. James Y. Craig in command.

Complete itinerary of the survey flight calls for landings at Stevenville and Gander, Newfoundland; Shannon Airport, Ireland; Prestwick, Scotland; Valley, Wales, with visits to the airports of Aldergrove, Bovingdon and Hurn in England; also Copenhagen, Denmark; Stavanger and Oslo, Norway; Stockholm and Gotteborg, Sweden; Meeks Field, Iceland; Goose Bay, Labrador; and return to LaGuardia Field, New York.

The purpose of this and succeeding survey flights is to determine what operations facilities are available along the new routes granted the company. This will include a survey of communications, navigation and airport facilities on future routes of operations.

Capt. B. J. Bergesen, Superintendent of Flight Operations for American Export Airlines, who is in charge of the survey, announced that regularly scheduled landplane service would be inaugurated on or about October 15th.

CROYDON–BRUSSELS

S.A.B.E.N.A., the Belgium Air Transport Co., expects to start operating a regular service between Croydon and Brussels some time this month.

The service is to be run on a daily frequency limited initially to priority passengers and freight.

ARCTIC FLIGHT

A SOVIET aircraft—the U.S.S.R.331—on a research flight into the Arctic has reached the wintering station of Cape Chelyuskin, in Northern Siberia, it was announced by Moscow Radio, quoted by Reuter.

Using the wintering station as their base, the crew of the U.S.S.R.331 will make flights totalling about 100 flying hours to investigate ice conditions in the Arctic's post-navigation season, collect data to determine the regularity of freezing in the Arctic icefields and the process of ice formation.

WANTED: AN AGREEMENT

THE South African Government has been asked by the United States Government to conclude an agreement to establish an American air passenger service between New York and Johannesburg.

An American company—probably Pan American Airways—is expected to apply shortly for permission to operate between the two countries.

TRANSPORT COMMAND SERVICES

ALL air services of Transport Command will continue to be regulated solely by military requirements and non-military traffic will only be carried within the limits of the capacity remaining after military needs have been met.

Passengers and freight will require to be sponsored by or on behalf of a Government department in the U.K. or by the appropriate representative of the British Government overseas. Priorities for fare-paying passengers and freight will be decided by the appropriate priority boards under the same conditions as operate at present. It will be the duty of the sponsoring authority to indicate in each application whether the charge should be waived or, if not, whether it should be raised against the department or paid by the passenger.

NEGOTIATIONS

DISCUSSIONS on the future of British and Irish interests in the transatlantic air route were scheduled to take place in London on the occasion of the visit of Mr. Sean Lemass, Eire's Deputy Prime Minister. Mr. Lemass is also Minister for Industry and Commerce—the department which controls civil aviation in Eire—and is accompanied by Mr. Sean Leydon, who is the Government Director on the Board of Kerrianta Teoranta (Irish airlines), and was Eire's representative at the Chicago Conference last year.

Before the war a plan was made for the establishment of a joint operating company for the route, shares being held by Britain, Canada, Newfoundland and Eire. The outbreak of war caused the abandonment of the plan on the transfer of operations on the North Atlantic route to the British Overseas Airways Corporation under a temporary arrangement which the Irish Minister recently declared could be terminated at any time. It is believed in Dublin that the discussions in London with Lord Winster will lead to the preparation of a new agreement.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

PRIDE IN UNIFORMS

Why Should the R.A.F. be the Worst-dressed Service?

IN the "Outlook" of September 27th your leader-writer remarks that "pride in uniform has a great influence in swelling the *moral* of any fighting service."

I couldn't agree more, but I do not feel that the uniform as at present worn by the rank and file of the R.A.F. can possibly have any such influence. It is of poor material, usually badly fitting and, when worn with a pair of over-size issue boots, probably gives A/C. Plonk an inferiority complex which will take years to eradicate.

Now that the war is over, the need for absolute economy in equipment should disappear, and the time has come for a re-consideration of the whole matter if recruitment is to be satisfactory. Then Master Plonk may in future walk abroad as proudly as Naval ratings and Guards privates.

"GROUP ELEVEN."

AIR MAIL SERVICE

London-Colombo Takes Six Days

I HAVE just noticed the paragraph in *Flight* of June 28th stating that the average transmission time for air mail from London to Colombo is still six weeks.

I have been aboard an aircraft carrier operating with the East Indies Fleet for the past six months, and would like to state that the average transmission time over the past six months has been six days. Even when we have been operating off the Malay Peninsular, and part of the journey is by destroyer, we have regularly received mail in nine days.

I would also mention that the speedy mail service has been a large contribution to the contentment of the men on this station, making us realise that with modern communications we are not so far from home after all. The average time for sea mail is from eight weeks to twelve weeks.

I consider most of the boys in the ships in the Fleet will agree with me when I say that we do appreciate the efforts that have been made to give us this speedy service—which is free.

AIR ENGINEER.

[This letter took 16 days to reach us.—ED.]

BEFORE THE ARK

Conversions, Adaptations and Compromises

I FEEL I must reply to Mr. Dawson's dogmatic assertions in his letter to *Flight*, September 20th, in which, whilst criticising my generalisation, he appears, in my view, to fall into a common error concerning the carrier *Hermes*, sunk off Ceylon.

It is true that this ship was built as an aircraft carrier for the Navy; but in the years of her building designers, constructors and even Service squadrons had only the haziest notion of what was required to operate squadrons from a carrier. I may mention, for examples, provision for aircraft stores and maintenance shops which, in almost every instance, were squeezed as afterthoughts—if at all—into any space which might fortuitously be available. This was the case with *Hermes* and all other British carriers before the 1938 *Ark Royal*, and so, without going into a mass of detail in support, it must be admitted that the pre-war carriers before *Ark Royal* embraced the conversions, adaptations and compromises which I stated in *Flight*, September 6, 1945.

In the *Ark*, for the first time, the air people were consulted, and anyone closely in touch with naval air affairs will be able to say how immense were the changes incorporated, not as modifications or alterations subsequently, but in the original design and building of the ship.

B. J. HURREN.

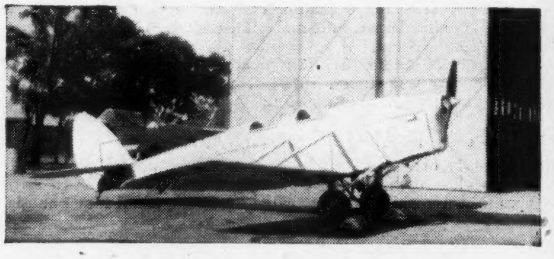
TAXYING TRAINER

Tiger Moth Conversion for A.T.C.

WITH the reduction in the size of the Royal Air Force, and consequent lessening of training requirements, there will, no doubt, be a considerable surplus of Tiger Moth aircraft, and it occurs to me that a number of these could be converted for use with the Air Training Corps as was done in Southern Rhodesia some two or three years ago.

As the accompanying photograph shows, the "Hoppity" trainer, as it was called, consists of a standard Tiger Moth fuselage with the lower wings only attached. In point of fact, these wings were reduced in span so that they could be braced to the top longerons of the fuselage by means of the normal inter-plane struts. The undercarriage was shortened so that the wing was fairly low on the ground, this being done for the double purpose of easier mounting, and to lower the C.G. so that the "aircraft" could not easily be turned on to its nose. In addition, the engine was adjusted so that it would not run at more than 1,400 r.p.m., and the airscrew also lessened in diameter, this being done in order that there might be no fear of some venturesome soul becoming airborne!

In order to make rudder movement a little easier, an extra pair of kingposts was fitted to the tail skid, these being larger than standard. Finally, the usual instruments were painted on to the dashboard, only the oil pressure gauge being genuine. The petrol tank holding one gallon of fuel, sufficient for about one hour's taxying, was placed under the fairing, just forward of the front dashboard.



The Rhodesian "Hoppity" ground trainer, once a Tiger Moth.

The "Hoppity" was very popular with the A.T.C. Cadets in Salisbury, and a large number of taxying hours were put in under the guidance of one or other of the local flying instructors of the Rhodesian Air Training Group. As a result, when the cadets were able to make their periodical flights in the real Tigers, they were quite able to taxi out before the flight and back after it, which, as they usually took over in the air as well, pleased them a lot.

It seems to me that a "Hoppity" would go well as a complement to the gliders at the A.T.C. gliding schools, and I submit the suggestion to those in authority.

C. A. NEPEAN BISHOP (Flt. Lt.).

CAMPAIGN AWARDS

". . . . Enough of These Petty Jealousies"

"POTAG'S" letter to your column has caused quite a few smiles among the pilots of our squadron. Isn't it about time we had enough of these petty jealousies about medals? Valuable space which could be used for interesting subjects in *Flight* is wasted almost every week by some frustrated person or other whose life and prestige apparently depends on a piece of coloured ribbon.

I disagree with "Potag's" statement that the F.A.A. has not received its share of publicity. The newsreels are full of carrier-borne aircraft taking off and landing, whilst the public very rarely see the R.A.F. in action.

As for his suggestion that the "Europe" be deleted from the "Air Crew Europe Star," may I suggest that the "Asiatic Star" be renamed the "Ocean Star" or even the "Sea Crossing Star" to give Bomber and Fighter Commands credit for their long and often arduous sea crossings; also that a medal be struck for the "Tommy" in the trenches whose job was just as important as ours and who receives no recognition and much less pay? Why should "Air Crew" have their own star?

No doubt "Potag" already qualifies for one or more of the other campaign stars, and if the word "Europe" be deleted from this star, surely the object—that of a campaign award—is defeated. Of necessity, then, the other stars would become unobtainable to all aircrews.

Incidentally, the public have only to recall Lt. Cdr. Esmonde's brilliant sacrifice which gained him the V.C. to realise the magnificent work the F.A.A. has done during the war.

FLT. LT. A. N. WERNER, R.A.F.
R.A.F.O.

A Matter Requiring Reconsideration

I HAVE just read "Potag's" letter (*Flight*, September 27th), in which he suggests that naval aircrews have had a raw deal in the recent distribution of campaign stars, and that

CORRESPONDENCE

the word "Europe" should be dropped from the Aircrew Europe Star, thus making it more generally available to the Naval Air Branch.

May I suggest that he has got the wrong idea? Just as there are very few in the Navy who qualify for the Aircrew Europe Star, so there are proportionately few in the R.A.F. who qualify for the Atlantic Star—and practically none in the Army who qualify for either. Any time "Potag" spent operating over Norway from carriers qualifies for the Atlantic Star, and I submit it is only right that it should be rewarded with a medal associated with the Navy, since it was purely a Naval operation. Similarly, it is natural that Naval squadrons lent to the R.A.F. and operating from shore bases under Air Force control should receive what is primarily an R.A.F. award—the Aircrew Europe Medal—as they do.

There is, however, one matter that I think requires reconsideration, and that is the rule that any individual that qualifies for the Aircrew Europe Star, the Atlantic Star, and the France and Germany Star, or for any two of these, may only wear the star first earned, though a rosette will indicate that the other service has been rendered. These ribbons commemorate quite separate campaigns—or at least as separate as, for example, the African, Italian and French campaigns—and this ruling makes it possible for men who have served operationally throughout the war to be rewarded with only one medal besides the "NAAFI gong." Would it not be preferable to limit the number one man can gain to the first five won—any addition being represented by rosettes—rather than to a specific five which penalises some without touching others?

If I may be permitted to quote my own case, I find that after three years' operational service, in which I have served with the R.A.F. over Europe and with the Navy over the Atlantic, Norway, and so on, I can only wear the Aircrew Europe Star, though I qualify easily for all three mentioned above.

"AIR BRANCH TYPE."

R.A.F. Aircrew Also Unrewarded

AFTER reading a letter in *Flight*, September 27th, from a F.A.A. correspondent, concerning campaign awards to flying personnel, I can assure him that R.A.F. airmen have had the same injustice dealt out to them, as have naval flyers.

Despite the fact that Bomber Command alone lost, "officially," half of its aircrews, there are hundreds, perhaps thousands, of men whose services have apparently passed unrewarded. Crews who did as many as 35 operational trips over Europe, including work in Norwegian waters, are ineligible to wear the "Air Crew Europe Star"!!

They are not entitled to this award because their operations were carried out after D-Day, when opposition was as desperate as ever. Nor are many of these same airmen able to display a Defence Medal, regardless of the fact that they have been in the service during the last four years.

Perhaps we can only hope that if these mistakes are to be rectified, both for the F.A.A. and the R.A.F., the persons responsible for the remedy will know a little about the job. For I, personally, think that the department entrusted with the task at present must surely be a horticultural society, who specialise in engineering.

"CELER."

BOOK REVIEWS

"Aviation," by H. E. Wimperis, C.B., C.B.E., etc.; Oxford University Press.

THIS is a volume in the series called the Home University Library, and no better man than Mr. Wimperis could have been chosen to write it. He explains that before examining the applications of flight it is well to give a technical background. His first chapters, therefore, deal with "The Growth of Flying" and "The Research Endeavour." These are not written for experts. A Fellow of the Royal Aeronautical Society might perhaps call them almost childishly elementary. On the other hand, a layman who does not understand the principles which enable a craft that is heavier than air to support itself in the air might put them down as double Dutch. But there are now many people who stand halfway between those two extremes, who know a certain amount and want to learn more. They will find these chapters very useful.

Having cleared the way, Mr. Wimperis goes on to aircraft in war and in peace. He has a good deal to say about the theories of Douhet and Seversky, but prudently refrains from laying down the law himself. The chapter on the prospects of commercial flying is one of the most interesting in the book, and Mr. Wimperis has much that is valuable to say about subsidies, freedom of the air, competition, and similar matters. Due respect is paid to the prospects of jet propulsion.

The last chapter deals with the contribution which aircraft can make to world security. Mr. Wimperis examines all sides of the problem, and analyses the difficulties which attend each suggestion. This is a very valuable book. F. A. de V. R.

"I Couldn't Care Less," by Anthony Phelps; The Harborough Publishing Co., Ltd., 8s. 6d.

ENTERTAINING though it will be to all ex-ferry pilots and exciting, perhaps, to those who enjoy flying books and what are usually known as "racy" personal memoirs, I cannot help feeling that Mr. Phelps' entertaining biography has been published five years too soon. It is, in fact, the first book to appear which deals with the work of the A.T.A. and, as such, is well worth reading—but it will be much more attractive when detailed memories are beginning to fade and when the whole complicated business of war inevitably develops a kind of romantic nostalgia in the memories of those who took part in it.

Read so soon afterwards, there is a certain brittle unreality about it all and, in particular, about that "couldn't-care-less" attitude which seemed genuine enough at the time and which will seem natural again in due course when the edge has been worn off reality. Just now, in the period of reaction, the slang, and the state of mind which produced it, seem to be curiously dated, and the impression is increased by two of the author's tendencies—to write in forced journalese (. . . "wont to foregather" . . . and . . . "halcyon days" . . . sort of thing) and to show repeated signs of an exaggerated consciousness about the "right" things to do, to eat and to think. But the writing becomes distinctly more free and natural as the story continues.

After that sharp attack, I will confess that I enjoyed reading it and I know that all ex-A.T.A pilots, as well as those who had anything to do with the ferrying business, will feel that, generally speaking Mr. Phelps has correctly painted the picture of those exciting years from the airframe driver's angle. By way of postscript, surely the original definition for the A.T.A. was not "Ancient and Tattered" but "Ancient and Tired (or Terrified?) Airmen," and I believe it was coined by "Brad"—*the* founder-member of the organisation, now, unhappily, no longer with us.

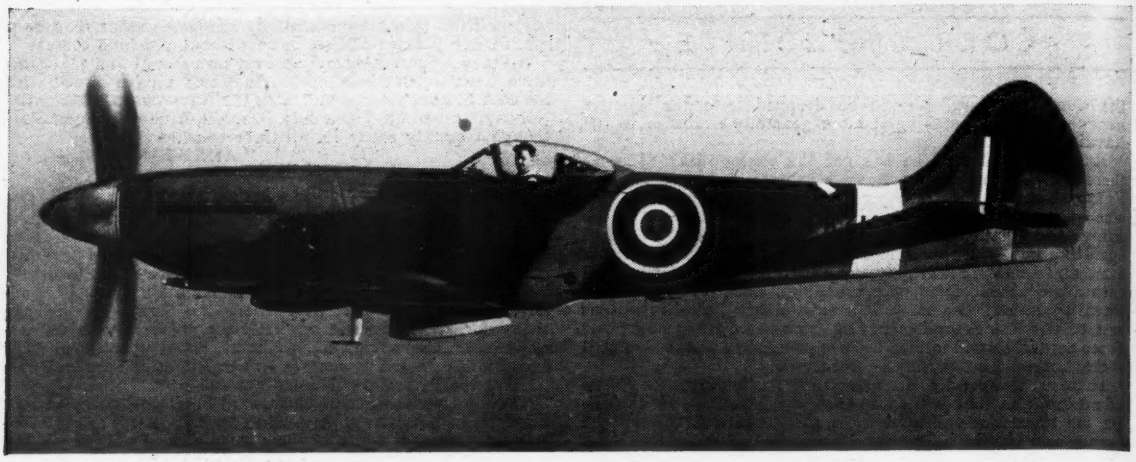
"Allan's Guide to the Pilot's 'A' Licence," by W. J. D. Allan; George Allen and Unwin, Ltd., 7s. 6d.

IT is encouraging to find someone already on the spot and ready to assist the prospective "A" licence queue. The very sight of the book gives one hope; maybe one day we shall be able again to buy and hire little flying machines. Whether or not the "A" licence qualifications will be modified remains to be seen; however necessary such modifications may seem, it is difficult not to be panic-stricken at the thought of the complicated regulations with which a well-organised bureaucracy might replace them.

In the meantime, the *Guide* is certainly very thorough, and the greater part of it will still be up to date whether there are qualification changes or not. Quite rightly, I feel, the author's sections dealing with the practical side of things are based on the general assumption that the type to be used will be "modern"; whether or not the revived clubs will be offered ex-Service biplane trainers in due course and to tide over the interim period, the pupil will need to know all about flaps, wheel-brakes, and the characteristics of present-day aircraft.

The entire business of learning to fly, from ground handling to navigation and general airmanship, is covered, with a full amount of information to get the pilot past the technical examination. As far as airfield control is concerned, the information covers pre-war practice, and this may, of course, be modified in view of Service control experience. One cannot feel that it is important nowadays to know the kind of lights which should be carried by an out-of-control airship!

Both the preliminary aerodynamics and the flying information is good and up to date, though one is not quite sure that the expert would agree with every one of the explanations and theories given. Some of the statements made in the practical sections apply to biplane trainers and not to flapped monoplanes, and, to be unduly liverish, the author should have known better than to spell Autogiro as "auto-gyro" unless he was deliberately trying to modify a word that is surely a "trade" name for a particular type. "INDICATOR."



LAST OF THE LINE : The latest Spitfire to be released—the Mark XXII—which possesses new wing and fuselage forms. No other country has a fighter with a story of success like the Spitfire, which, despite its age, is still in the forefront of the world's fighters.

SERVICE AVIATION

Royal Air Force and Naval Air Arm News and Announcements

Appointments

Royal Air Force

THE Air Ministry announces the following R.A.F. appointments :—

Air Vice-Marshal R. M. FOSTER, C.B., C.B.E., D.F.C., to be Chief of Air Division, Control Commission, Austria.

Air Vice-Marshal A. C. STEVENS, C.B., to be A.O.C. No. 47 Group.

Air Vice-Marshal R. I. CHAPMAN, C.B.E., D.F.C., A.F.C., to be A.O.C. No. 38 Group.

Air Vice-Marshal R. G. HART, C.B.E., M.C., to be Chief Signals Officer, Allied Control Commission.

Air Comdre. H. B. RUSSELL, C.B., D.F.C., A.F.C., to be Head of Disarmament Staff, British Air Forces of Occupation, and to be Act. Air Vice-Marshal.

Air Comdre. T. C. TRAILL, O.B.E., D.F.C., to be A.O.C. No. 83 Group.

Air Vice-Marshal Foster has been Air Officer Commanding, Desert Air Force, since December, 1944. He was previously A.O.C., Malta, and was on the Allied Military Control Commission, Italy. In 1942, he was A.O.C. Nos. 214 and 213 Groups.

At the outbreak of war he was S.A.S.O. at No. 2 (Bomber) Group, and later commanded a bomber squadron and a bomber station.

Air Vice-Marshal Stevens has been A.O.C., Gibraltar, since June, 1944. He was formerly Senior Air Staff Officer, No. 18 Group, and Deputy Director of Naval Co-operation at the Air Ministry.

Air Vice-Marshal R. I. Chapman, who has been a prisoner of war, was Base Commander at No. 13 Base in 1944. He was previously Director of Policy at the Air Ministry, and in 1940 commanded a bomber station.

At the outbreak of war he was at Headquarters, Bomber Command, on Air Staff operational duties.

Air Vice-Marshal Hart has been Chief Signals Officer at S.H.A.E.F. (Main Air) since October, 1944. He was previously Chief Signals Officer at Headquarters Fighter Command, and a Deputy Director of Signals at the Air Ministry.

At the outbreak of war he was on special signals duties at H.Q. Fighter Command.

Air Vice-Marshal Russell has been A.O.C. No. 70 Group since August, 1943.

He was previously A.O.C., No. 215 Group, and Air Officer in Charge of Administration, Western Desert.

In 1940 he was Senior Air Staff Officer at H.Q. Fighter Command.

Following various appointments at the Air Ministry from 1935 to 1939 he became Senior Air Staff Officer, No. 21 Group, and in 1940 became Senior Air Staff Officer, No. 2 Royal Air Force Component.

Air Comdre. Traill has been Director of Air Tactics, at the Air Ministry, since February, 1944.

He was formerly Deputy Chief of Staff (Operations), North-West African Air Forces, and Senior Air Staff Officer, No. 242 Group.

In 1941 he commanded R.A.F. Station, Middleton St. George, and in 1940 was at H.Q. Bomber Command, on Air Staff duties.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations :—

Bar to Distinguished Service Order

Act. Sqn. Ldr. K. H. F. LETFORD, D.S.O., D.F.C., R.A.F.V.R., No. 156 Sqn.—Sqn. Ldr. Letford is now on his fourth tour of operational duty. His skilful airmanship and fine fighting spirit have earned him the confidence of his crew and of the squadron. He is a fearless captain who has shown complete disregard for any opposition when pressing home his attacks. His courage and devotion to duty have been a splendid example to all who have served with him.

Distinguished Service Order

Wing Cdr. J. H. N. MOLESWORTH, D.F.C., A.F.C., R.A.F.V.R., No. 626 Sqn.—Since the award of the D.F.C., Wing Cdr. Molesworth has completed a number of successful sorties over enemy territory. These have included two attacks on Essen, as well as others on Duisburg, Zeitz and Dortmund. He has proved himself to be an efficient and inspiring squadron commander, whose initiative and skill have maintained the effectiveness of his unit at a high level during a period of intensive operational activity in difficult winter weather. At all times he has displayed fine qualities of leadership and courage.

Wing Cdr. B. G. D. NATHAN, R.A.F.O., No. 142 Sqn.—Wing Cdr. Nathan has completed a large number of operational missions. Many of these were in support of the invasion of the Continent in June, 1944, and others included deep penetrations of enemy territory to attack such targets as Stuttgart and Stettin. As a squadron commander he has built up his unit into a most efficient force which has set up a fine operational record. Wing Cdr. Nathan has personally taken part in many hazardous sorties. His coolness, courage and leadership have been of great value to his squadron.

Act. Wing Cdr. J. M. BAZIN, D.F.C., A.A.F., No. 9 Sqn.—After completing a tour of operations with Fighter Command, during which he was awarded the D.F.C., this officer volunteered for operations with Bomber Command. Whilst in command of his present squadron he has completed many hazardous sorties. He has led his squadron on nearly every one of its daylight attacks, many of them against heavily defended targets, including shipping at Brest, and two attacks on the *Tirpitz*. Since Wing Cdr. Bazin assumed command of his squadron he has trained it in the operation of new equipment, and the very high operational standard reached has been largely due to his untiring work and devotion to duty.

Act. Wing Cdr. H. H. BURNELL, A.F.C., R.A.F.O., No. 223 Sqn.—This officer has had a long and varied operational career, and has commanded a squadron since September, 1944. His present command entailed the formation of a new squadron, its equipment with American aircraft and the training of suitable crews. This duty has demanded much initiative and organisation combined with the most arduous attention to detail. Wing Cdr. Burnell has completed this task with distinction, and has, in addition, flown regularly on operations. Under his leadership his squadron has achieved great success on bomber support missions, particularly arducus operations, which this officer has completed with commendable thoroughness and enthusiasm.

Act. Wing Cdr. T. C. MURRAY, D.F.C., R.A.F.O., No. 138 Sqn.—This officer is an exceptionally keen and inspiring leader, whose enthusiasm and devotion to duty in the face of the enemy have always been of the highest order. Since the award of the D.F.C. he has led his squadron on a number of important attacks with unfailing precision and determination. Wing Cdr. Murray has taken part in numerous operations of a difficult and hazardous nature, always displaying most outstanding gallantry and tenacity.

Sqn. Ldr. W. F. CALDOW, A.F.C., D.F.M., R.A.F.V.R., No. 550 Sqn.—This officer has completed two tours of operational duty. On his second tour most of his missions have involved deep penetration into German territory to attack the more distant and heavily defended enemy objectives. Throughout these long and arduous flights, Sqn. Ldr. Caldow has displayed great skill, courage and tenacity, which have contributed much to the success achieved. As deputy squadron commander this officer's capable direction has been a valuable asset to his unit.

Act. Sqn. Ldr. W. ALLAN, D.F.C., R.A.F.V.R., No. 10. Sqn.—Sqn. Ldr. Allan has completed two tours of operational duty, during which he has attacked such heavily defended targets as Essen, Dusseldorf, Magdeburg and Osnabruck. On one occasion, in October, 1944, this officer was detailed for an attack against Cologne. Shortly after crossing the English coast, one of the engines of his aircraft became unserviceable; nevertheless, Sqn. Ldr. Allan pressed on and bombed the target from a low level. Severe anti-aircraft fire was encountered at that height, causing damage to his aircraft, but, with great skill, this officer flew the bomber safely back to base. A flight commander of outstanding ability and a skilful and courageous pilot and captain of aircraft, Sqn. Ldr. Allan has materially contributed to the high standard of operational efficiency attained by his squadron.

Act. Sqn. Ldr. A. T. BUCKLAND, D.F.C., R.A.F.V.R., No. 109 Sqn.—Sqn. Ldr. Buckland has recently completed his second tour of operational duty. The great majority of his sorties have been attacks on German objectives in the capacity of target marker. Despite the heavy anti-aircraft opposition encountered over such targets, the results achieved by Sqn. Ldr. Buckland have always been of the highest standard. In the role of flight commander, this officer's determined efforts to increase the efficiency of his crews has had excellent results. Sqn. Ldr. Buckland has always exhibited outstanding qualities of leadership and courage.

Act. Sqn. Ldr. R. D. DOLEMAN, D.F.C., R.A.F.V.R., No. 157 Sqn.—Since the award of the D.F.C. Sqn. Ldr. Doleman has destroyed three enemy aircraft, two of which were destroyed on the same night, bringing his total victories to seven enemy aircraft destroyed He has served

SERVICE AVIATION

continuously on operations since May, 1941, and has taken part in sorties all over the European theatre of war and the Bay of Biscay. On many of his missions heavy opposition has been encountered, but, despite this, Sqn. Ldr. Doleman has always shown great skill, determination and courage. His sustained gallantry and initiative have been of the highest order.

Act. Sqn. Ldr. G. W. HARDING, D.F.C., R.A.F., No. 105 Sqn.—Sqn. Ldr. Harding has been successfully completing the duties of flight commander for a considerable period. Since the award of the D.F.C. most of his sorties have been with the Pathfinder Force in the role of target marker. He has shown, in this capacity, very high qualities of skill, judgment and a determination to press home his attacks to the utmost. In more recent attacks on targets in the Ruhr and Rhineland, these qualities have enabled Sqn. Ldr. Harding to set up an impressive operational record and one which has been of the greatest value to the squadron.

Bar to Distinguished Flying Cross

Act. Wing Cdr. H. J. DAVIES, D.S.O., D.F.C., R.A.F.V.R., No. 7 Sqn
Act Wing Cdr. L. G. A. WHYTE, D.F.C., R.A.F.V.R., No. 102 Sqn.
Act. Sqn. Ldr. I. L. T. ACKROYD, D.F.C., R.A.F.V.R., No. 105 Sqn.
Act. Sqn. Ldr. H. G. A'COURT, D.F.C., R.A.F.V.R., No. 109 Sqn.
Act. Sqn. Ldr. R. H. CANEVER, D.F.C., R.A.F.V.R., No. 97 Sqn.
Act. Sqn. Ldr. W. L. FARQUHARSON, D.F.C., R.A.F.V.R., No. 195 Sqn.
Act. Sqn. Ldr. G. R. HAWES, D.F.C., R.A.F.V.R., No. 635 Sqn.
Act. Sqn. Ldr. P. REYNOLDS, D.F.C., R.A.F.V.R., No. 186 Sqn.
Act. Sqn. Ldr R. WATERS, D.F.C., R.A.F., No. 166 Sqn. (Lt. the Royal Regiment of Artillery).
Flt. Lt. D. F. BATEMAN, D.F.C., R.A.F.V.R., No. 142 Sqn.
Flt. Lt. J. P. BLACKIE, D.F.C., R.A.F.V.R., No. 7 Sqn.
Flt. Lt. W. A. C. BOWEN, D.F.C., R.A.F.V.R., No. 105 Sqn.
Flt. Lt. I. T. CHAMBERS, D.F.C., R.A.F.V.R., No. 142 Sqn.
Flt. Lt. W. B. ELLIS, D.F.C., R.A.F.V.R., No. 7 Sqn.
Flt. Lt. A. H. FERNAND, D.F.C., R.A.F.V.R., No. 109 Sqn.
Flt. Lt. J. W. GEE, D.F.C., R.A.F.V.R., No. 153 Sqn.
Flt. Lt. D. R. HOWARD, D.F.C., R.A.F.V.R. (Bomber Support Development Unit).
Flt. Lt. W. JONES, D.F.C., R.A.F.V.R., No. 105 Sqn.
Flt. Lt. E. J. LISLE, D.F.C., R.A.F., No. 7 Sqn.
Flt. Lt. G. A. MARTIN, D.S.O., D.F.C., R.A.F.V.R., No. 405 (R.C.A.F.) Sqn.
Flt. Lt. J. A. RUCK, D.F.C., R.A.F.V.R., No. 105 Sqn.
Flt. Lt. D TIDY, D.F.C., R.A.F.V.R., No. 105 Sqn.
Flt. Lt. T. C. TREADWELL, D.F.C., R.A.F.V.R., No. 10 Sqn.
Act. Flt. Lt. G. H. BARR, D.F.C., R.A.F.V.R., No. 105 Sqn.
Act. Flt. Lt. R. COOPER, D.F.C., R.A.F.V.R., No. 169 Sqn.
Act. Flt. Lt. E. L. FIELD, D.F.C., R.A.F.V.R., No. 186 Sqn.
Act. Flt. Lt. C. R. GODFREY, D.F.C., R.A.F.V.R., No. 635 Sqn.
Act. Flt. Lt. G. E. LOCKEY, D.F.C., R.A.F.V.R., No. 83 Sqn.
Act. Flt. Lt. B. R. PENGILLEY, D.F.C., R.A.F.V.R., No. 582 Sqn.
Act. Flt. Lt. H. PETTIFER, D.F.C., R.A.F.V.R., No. 35 Sqn.
Act. Flt. Lt. W. SEARSTON, D.F.C., R.A.F.V.R., No. 7 Sqn.
Act. Flt. Lt. D. H. SHORTER, D.F.C., R.A.F.V.R., No. 97 Sqn.

Distinguished Flying Cross

Act. Wing Cdr. E. R. MILLINGTON, M.P., R.A.F.V.R., No. 227 Sqn.
Sqn. Ldr. R. O. LANE, R.A.F.V.R., No. 626 Sqn.
Sqn. Ldr. H. St. G. TURNER, R.A.F.O., No. 10 Sqn.
Act. Sqn. Ldr. C. N. HAGUES, A.F.C., R.A.F.V.R., No. 15 Sqn.
Act. Sqn. Ldr. K. W. HINDS, R.A.F.V.R., No. 12 Sqn.
Flt. Lt. P. F. G. ALCOCK, R.A.F.V.R., No. 139 Sqn.
Flt. Lt. C. BANHAM, D.F.M., R.A.F., No. 192 Sqn.
Flt. H. BROOKER, R.A.F.V.R., No 97 Sqn.
Flt. Lt. P. D. CHERRY, D.F.M., R.A.F., No. 7 Sqn.
Flt. Lt. A. J. DANIEL, R.A.F.V.R., No. 90 Sqn.
Flt. Lt. J. A. EDWARDS, R.A.F.V.R., No. 49 Sqn.
Flt Lt. J. H. HARWOOD, R.A.F.V.R., No. 100 Sqn.
Flt. Lt. J. HONNIBALL, R.A.F.V.R., No. 57 Sqn.
Flt. Lt. W. J. LARGE, R.A.F.V.R., No. 12 Sqn.
Flt. Lt. A. MACKINNON, R.A.F.V.R., No. 157 Sqn.
Flt. Lt. J. S. PUGH, R.A.F.V.R., No. 149 Sqn.
Flt. Lt. F. ROSE, R.A.F.V.R., No. 10 Sqn.
Flt. Lt. R. J. V. SMYTH, R.A.F.V.R., No. 157 Sqn.
Flt. Lt. W. H. TOLMAN, R.A.F.V.R., No. 150 Sqn.
Flt. Lt. L. G. TURNER, A.F.C., R.A.F.V.R., No. 35 Sqn.
Flt. Lt. J. C. WILSON, R.A.F.V.R., No. 625 Sqn.
Flt. Lt. J. WINTER, R.A.F.V.R., No. 49 Sqn.
Flt. Lt. L. H. WOOD, R.A.F., No. 10 Sqn.
Act Flt. Lt. J. G. BODEN, D.F.M., R.A.F.V.R., No. 7 Sqn.
Act. Flt. Lt. B. E. BROWN, R.A.F.V.R., No. 51 Sqn.
Act. Flt. Lt. J. H. COLE, B.E.M., R.A.F.V.R., No. 83 Sqn.
Act. Flt. Lt. D. H. COURTENAY, R.A.F.V.R., No. 635 Sqn.
Act. Flt. Lt. R. J. DAFFEY, D.F.M., R.A.F.V.R., No. 10 Sqn.

Badge of No. 848 Squadron, Naval Air Arm—"Accipe hoc" (Take that). On a red field, a plate charged with a hawk volant proper releasing a torpedo also proper, into water barry wavy in base blue and white.

Act. Flt. Lt. W E. HAMILTON, R.A.F.V.R., No. 106 Sqn.
Act. Flt. Lt. K. C. HAMPSON, R.A.F.V.R., No. 10 Sqn.

Distinguished Flying Medal

Flt. Sgt. J. H. ADDISON, R.A.F.V.R., No. 156 Sqn.
Flt. Sgt. L. AGLEY, R.A.F.V.R., No. 6 Sqn.
Flt. Sgt. G. M. BELL, R.A.F.V.R., No. 218 Sqn.
Flt. Sgt. A. W. BLACK, R.A.F.V.R., No. 156 Sqn.
Flt. Sgt. J. BEAGBROUGH, R.A.F.V.R., No. 617 Sqn.
Flt. Sgt. A. BROWN, R.A.F.V.R., No. 128 Sqn.
Flt. Sgt. H. BURTON, R.A.F.V.R., No. 218 Sqn.
Flt. Sgt. E. CHAMBERLAIN, R.A.F.V.R., No. 156 Sqn.
Flt. Sgt. J. CHURCH (now Pilot Officer), R.A.F.V.R., No. 405 (R.C.A.F.) Sqn.
Flt. Sgt. F. G. COGHILL, R.A.F.V.R., No. 7 Sqn.
Flt. Sgt. F. COLES, R.A.F.V.R., No. 625 Sqn.
Flt. Sgt. L. COLLINS, R.A.F.V.R., No. 186 Sqn.
Flt. Sgt. E. F. CRABB, R.A.F.V.R., No. 218 Sqn.
Flt. Sgt. N. W. CRINGLE, R.A.F.V.R., No. 7 Sqn.
Flt. Sgt. J. CRITCHLEY, R.A.F.V.R., No. 424 (R.A.F.) Sqn.
Flt. Sgt. E. DENT, R.A.F.V.R., No. 35 Sqn.
Flt. Sgt. T. DEWSBURY (now Warrant Officer), R.A.F.V.R., No. 75 (N.Z.) Sqn.
Flt. Sgt. T. G. DOYLE, R.A.F.V.R., No. 90 Sqn.
Flt. Sgt. F. S. EGGO (now W/O.), R.A.F., No. 77 Sqn.
Flt. Sgt. D. R. ELDERKIN, R.A.F.V.R., No. 7 Sqn.
Flt. Sgt. R. A. FARRELL, R.A.F.V.R., No. 625 Sqn.
Flt. Sgt. H. FOXTON, R.A.F.V.R., No. 35 Sqn.
Flt. Sgt. H. F. FRANK, R.A.F.V.R., No. 218 Sqn.
Flt. Sgt. J. T. GIBBINS, R.A.F.V.R., No. 142 Sqn.
Flt. Sgt. T. HEESOM, R.A.F.V.R., No. 101 Sqn.
Flt. Sgt. F. G. HOLLAND, R.A.F.V.R., No. 186 Sqn.

THE KING has been graciously pleased to approve the following awards:

Military Cross

Act. Flt. Lt. H. W. THOMPSON, D.F.C., R.A.F.V.R., No. 7 Sqn.
Flt. Lt J.. T. TAYLOR, R.A.F.V.R.

Military Medal

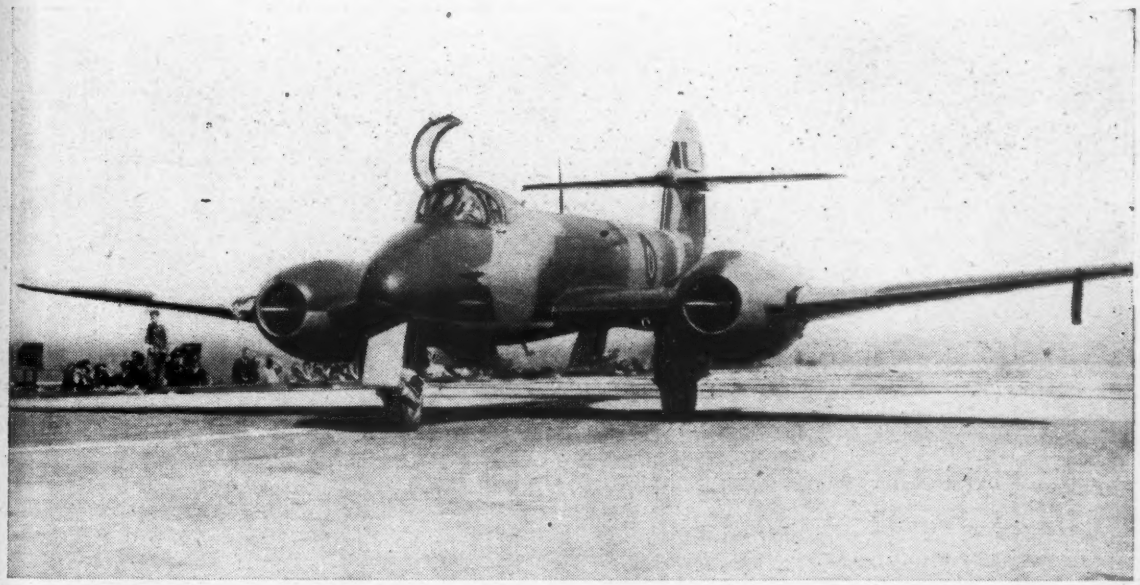
Cpl. S. ROGERSON, R.A.F.V.R.
L A/C. E. COXSHALL, R.A.F.V.R.

Army Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallant and distinguished services in the field:—

Distinguished Service Order

Lt. M. D. DAUNCEY, Glider Pilot Regt., Army Air Corps.



SEA METEOR: The Naval Air Arm is determined to keep up with land developments in aircraft. Here is a Gloster Meteor on the deck of an aircraft carrier—possibly the first jet aircraft to fly from a carrier.

SERVICE AVIATION

THE KING has been graciously pleased to approve the following awards in recognition of gallant and distinguished services in N.W. Europe:—

Bar to Distinguished Flying Cross

Capt. (temp.) W. S. MOLISON, Royal Regiment of Artillery (since killed in action).

Distinguished Flying Cross

Capt. (temp.) D. L. COURTNEY, Royal Regiment of Artillery.
Capt. (temp.) E. D. DETTMER, Royal Regiment of Artillery.
Capt. (temp.) B. HARGREAVES, Royal Regiment of Artillery.
Capt. (temp.) D. J. V. MURRAY, Royal Regiment of Artillery.

Roll of Honour

Casualty Communiqué No. 542.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 177 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. R. Adams; Flt. Sgt. L. W. Attewell; Flt. Sgt. R. R. Attreed; Sgt. D. J. Barlow; P/O. F. W. Birks; Flt. Sgt. K. H. Butcher; Sgt. H. A. C. Crisp; Sgt. L. A. Dutton; F/O. D. W. Edwards; P/O. K. G. Gleave; Flt. Sgt. G. J. C. Grant; F/O. F. J. Hales; Flt. Sgt. J. P. Hughes; F/O. R. W. C. Jamieson; Flt. Sgt. P. Knights; Sgt. A. G. S. Laidlaw; Flt. Sgt. W. G. Lawrence; Sgt. C. Main; Sgt. A. Nicholson; Flt. Sgt. T. B. Nicholson; Sgt. D. H. Roberts; P/O. R. F. C. Sharp; F/O. A. M. Shaw; Sgt. G. H. Simmonds; W/O. H. Simms; Sgt. J. K. Smith; W/O. J. D. Wood.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. J. R. Brodby; Sgt. W. Dobie; Flt. Sgt. W. R. Heel; Sgt. F. T. Jones; Cpl. F. N. Lawrence; Sgt. P. G. MacKay; Flt. Sgt. R. E. Piper; Flt. Sgt. E. Rigby; P/O. J. M. Roberts; Flt. Sgt. H. A. Stares.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. T. E. Archard; Sgt. A. M. Armin; Sgt. L. J. Arthur; F/O. R. C. C. Atkins; Flt. Sgt. L. S. Baldwin; Flt. Sgt. D. F. Ball; P/O. R. E. Beadle; Sgt. J. O. Beagley; Flt. Sgt. C. F. Bish; Sgt. D. Bissett; Sgt. C. T. Brown; Flt. Sgt. G. H. Brown; Sgt. H. C. J. Buckler; Flt. Sgt. J. Burnside, D.F.M.; Flt. Sgt. H. D. Chappell; Sgt. L. Craven; Sgt. R. J. Crawford; Sgt. K. D. Crothers; F/O. L. J. Darby; Sgt. J. R. Davies; Sgt. F. L. Dawson; Ac. Sqn. Ldr. T. H. D. Drinkwater, D.F.C.; Flt. Sgt. J. R. Elliott; F/O. K. Fishwick; Sgt. B. Forshaw; Sgt. G. E. Gilpin; Flt. Sgt. F. J. Goodale; Sgt. F. J. Graham; Sgt. H. K. Grant; Sgt. J. Gresty; F/O. R. E. Haddock; Sgt. S. S. J. Haines; P/O. A. Handley; Sgt. A. Hargill; Sgt. D. Howells; Sgt. D. St. C. Ingram; Flt. Sgt. C. Jackson; P/O. G. C. Jennison; Flt. Sgt. W. Kelly; F/O. A. G. Lodge; F/O. C. H. Lowcock; W/O. R. Lowe; Sgt. R. W. Lucas; P/O. F. S. McFarlin; Sgt. J. N. McKenna; Flt. Sgt. W. J. Manley; F/O. J. F. V. Marshall; Sgt. R. H. Martin; Sgt. W. B. May; P/O. K. W. Mitchell; Flt. Sgt. S. Morris; Flt. Lt. G. A. Morrison, D.S.O.; Sgt. D. R. Mussett; Sgt. H. Newton; Sgt. F. Oliver; Sgt. E. G. L. Parker; Act. Sqn. Ldr. S. M. P. Parkes; F/O. C. Passingham; Sgt. D. F. Pegrum; F/O. E. R. Penman; Sgt. J. Potter; Flt. Sgt. E. W. R. Pratt; W/O. A. T. Redfern; F/O. G. E. J. Reynolds; Act. Sqn. Ldr. W. C. Riches, D.F.C.; Flt. Sgt. R. Rowell; Flt. Sgt. R. Satchell; P/O. C. C. Scrimshaw; Sgt. H. A. Shephard; Flt. Sgt. J. S. Sutherland; Sqn. Ldr. H. Swanston; Flt. Sgt. R. A. Tapp; Sqn. Ldr. J. B. Weightman, D.F.C.; F/O. D. A. Wiener; Sgt. E. Wilkinson; P/O. R. E. N. Wood; Flt. Lt. R. L. Wood; Sgt. J. E. G. Woodward; Act. Flt. Sgt. A. K. Wooliscroft; P/O. T. K. Wright; Sgt. W. H. Slater.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. A. J. Scares.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. E. Brunskill; Sgt. F. Evans.

WOUNDED OR INJURED IN ACTION.—F/O. C. R. Barker; Sgt. J. Benson; F/O. B. C. Bruce-Gardner; F/O. W. S. S. Hamilton; Sgt. W. W. J. Pritchard; Sgt. J. W. Rudkin; F/O. P. J. Spellman; Sgt. M. F. W. Walker.

MISSING, BELIEVED KILLED IN ACTION.—F/O. H. E. C. Aylward; Flt. Sgt. K. Bullimore; F/O. A. G. Ife; F/O. R. J. Sassoon; Sgt. C. Walker; P/O. W. B. Weir.

MISSING.—Act. Flt. Lt. A. H. Aitken; F/O. P. W. Berry; Sgt. H. J. E. Brownett; W/O. C. Buckley; F/O. S. Carpenter; P/O. R. A. Caston; Sgt. R. E. Chapman; Sgt. B. V. Clinton; Flt. Lt. P. A. Disney; Sgt. W. Field; F/O. A. Fisken; Flt. Sgt. R. G. L. Haxton; F/O. J. Hopwood; Sgt. W. Horrocks; F/O. H. A. Horsey; F/O. Sir C. W. Hoskyns; Flt. Sgt. E. L. Howard; Sgt. W. H. R. Jenkins; Flt. Sgt. C. M. Lett; F/O. H. J. Lodge; Sgt. H. C. Lomax; P/O. R. P. Marvin; Flt. Sgt. T. B. Moore; Flt. Sgt. M. S. Munro; P/O. J. Nevens; Flt. Sgt. D. B. O'Brien; Sqn. Ldr. M. W. O'Brien, D.F.C.; Sgt. D. G. Parbery; Flt. Sgt. A. R. Paton; P/O. W. L. Shaw; Sgt. F. F. Sinclair; Flt. Lt. C. A. B. Slack; Flt. Sgt. H. R. Sproston; F/O. R. W. Stephens; P/O. R. A. Swift; W/O. R. E. M. Thomas; F/O. P. J. R. Viney; Sgt. S. C. Walton; F/O. F. Waterland; Sgt. L. Williams; Sgt. F. Wright.

KILLED ON ACTIVE SERVICE.—L.A/C. H. H. Ball; Sgt. R. K. Baylor; Act. Flt. Lt. G. A. Clark; F/O. N. E. Cook; F/O. G. R. Cooke; F/O. G. L. Davies; Sgt. G. Gore; Flt. Sgt. B. F. Griggs; Flt. Sgt. W. J. Hodgkiss; A/C.1 E. Howell; Flt. Sgt. T. H. Judge; P/O. G. Mantus; F/O. T. Neale; F/O. D. O'Brien; Wing Cdr. G. L. Raphael, D.S.O., D.F.C.; Flt. Lt. R. C. P. Rigg; Sgt. J. F. J. Stanley; F/O. J. A. Taylor; Sgt. R. E. Tucker; P/O. K. F. L. Usher; P/O. K. G. Whiteside; W/O. R. C. Wingrove; Flt. Sgt. B. C. Winser; Sgt. J. Winterbotom.

MISSING, BELIEVED KILLED, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Lt. C. G. Robertson, D.F.C.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. E. Gordon; F/O. J. Morse.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. S. C. Cleaver; Cpl. A. G. Gauntlet; L.A/C. T. T. Hewitt; Flt. Sgt. D. J. Johnson; W/O. A. Pontet-Piccolomini; Sqn. Ldr. C. R. Sarel; Act. Flt. Lt. W. N. Wootton.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Flt. Sgt. K. T. Gill; F/O. J. Henry; Sgt. E. Hills; Flt. Sgt. M. K. Lambert; W/O. R. Thompson.

DIED ON ACTIVE SERVICE.—A/C.1 F. H. Barley; Cpl. J. Best; L.A/C. P. J. Breen; Sgt. W. A. Byrd; Flt. Sgt. R. Dickie; L.A/C. R. H. Gunn; L.A/C. S. G. Jackson; L.A/C. T. B. King; Flt. Sgt. A. L. Privett; W/O. J. Smith; Cpl. S. J. Thompson.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—L.A/CW. E. M. Crawford; L.A/CW. N. M. Roberts.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Lt. R. C. Kennedy; Flt. Lt. D. D. Kimber.

MISSING, BELIEVED KILLED IN ACTION.—F/O. W. H. Long.

MISSING.—P/O. K. R. Bruce; Act. F/O. A. B. Fischer; W/O. D. E. Hunt; F/O. J. H. Palmer; F/O. N. J. Rankin.

KILLED ON ACTIVE SERVICE.—W/O. K. W. Ainsworth; F/O. W. G. Craig, D.F.C.; Flt. Lt. J. Thomson.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. G. W. Ferguson; F/O. D. C. McLeod; F/O. R. A. Porritt; Flt. Lt. W. K. Scharff.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. J. F. Andrews; F/O. W. L. Baker; P/O. H. D. Beames; Flt. Sgt. B. G. H. R. Bean; Wing Cdr. R. J. Bennell, D.F.C.; W/O. G. H. Bentinck; P/O. C. Bertoia; F/O. H. H. Borchardt; W/O. L. G. Carson; Flt. Sgt. J. M. Cassady; Sgt. J. T. E. Chalk; P/O. J. A. L. Charest; F/O. J. M. Cowie; Flt. Lt. J. A. C. Crimmins; P/O. J. L. Donald; F/O. J. L. Emery; F/O. W. C. Fairgrieve; F/O. A. J. Faulkner; P/O. W. R. Ferrier; P/O. J. B. Fraser; F/O. H. R. Good; P/O. E. A. Goodwin; P/O. W. R. Hewetson; W/O. J. H. Inch; Flt. Lt. K. D. Kemp; P/O. E. Kisilowsky; Flt. Sgt. H. E. Lawson; W/O. D. B. Lorenz; W/O. N. A. F. MacKenzie; Flt. Lt. R. M. McKenzie; P/O. A. McG. Matheson; F/O. V. L. Miles; Sgt. M. Minett; Sgt. G. D. Mitchell; F/O. F. W. Moffit; P/O. D. O. Munson; W/O. S. Mydaski; F/O. J. M. Neal; F/O. K. A. Nordheimer; F/O. R. W. Ollett; F/O. L. K. Owen P/O. E. E. F. Park; F/O. G. H. Parker; F/O. W. W. Price; P/O. A. E. Rickert; F/O. W. Ross; F/O. D. T. Ryan; P/O. A. G. S. Simard; P/O. S. Simm; W/O. J. Sirovyak; F/O. J. R. G. Srigley; P/O. T. E. Swinton; W/O. L. P. R. Taillefer; P/O. B. E. Vipond; F/O. J. A. Webber; F/O. C. D. Woodley; P/O. S. E. Woolhether; F/O. V. F. Wunsch.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Flt. Sgt. R. C. Hase; Flt. Lt. W. N. MacPherson.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—W/O. N. R. Orton.

MISSING.—W/O. S. G. Campbell; Flt. Sgt. E. Dwyer; W/O. W. Gill; Flt. Sgt. A. W. Holmes; Flt. Lt. F. J. Ling; W/O. E. W. McCready; F/O. A. B. S. McElroy; Flt. Sgt. R. B. Millman; F/O. J. M. J. Powell; Flt. Sgt. A. W. Preston; Flt. Lt. A. G. Rawland; Flt. Sgt. W. M. Richmond; F/O. B. W. Rudland; Flt. Sgt. E. W. Sivell; F/O. G. H. Small; Flt. Sgt. I. F. Tait; W/O. R. Taylor; W/O. R. L. Thompson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. J. R. Bradley; Flt. Sgt. J. W. Topscher.

Badge of No. 894 Squadron, Naval Air Arm — "Omnium capax ubique" (Capable of anything anywhere). On a blue field a seahorse winged white.

Royal New Zealand Air Force

KILLED IN ACTION.—Flt. Sgt. R. J. McL. Bell; Act. Flt. Lt. V. G. Cave; F/O. R. A. Egley; F/O. W. A. Kaika.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—W/O. T. W. Buckley.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. J. M. Aitken; W/O. B. G. Barton; F/O. R. C. Beazer; F/O. E. G. Blake; P/O. D. G. Blackmore; Flt. Sgt. R. H. Brown; Flt. Sgt. L. S. Jamieson; Flt. Sgt. T. A. Peevers; F/O. T. A. Pettitt; P/O. L. S. Smith; F/O. W. Tye; P/O. W. J. Willis; P/O. J. A. S. Wright.

MISSING.—Act. F/O. R. F. Wallace.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. B. S. Browne.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Lt. B. D. Jenkins.

WOUNDED OR INJURED IN ACTION.—Maj. A. R. A. Peats.

Official Corrections

Casualty Communiqué No. 540.

Insert "MISSING, BELIEVED KILLED IN ACTION," and following names thereunder: P/O. S. G. Eden; Sgt. J. R. Hyne; F/O. D. H. Loder; F/O. K. H. Roe.

Casualty Communiqué No. 541.

Under "PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION," for Sgt. E. R. Kingham read Sgt. E. R. Kingman.

Under "MISSING," for Sgt. R. J. Shepherd read Flt. Sgt. R. J. Shepherd.

FORERUNNER: A Firebrand I—the original Firebrand fitted with a Napier Sabre engine—on the carrier *Illustrious*, during aircraft trials on the Clyde. This picture was taken in February, 1943, but has only recently been released.